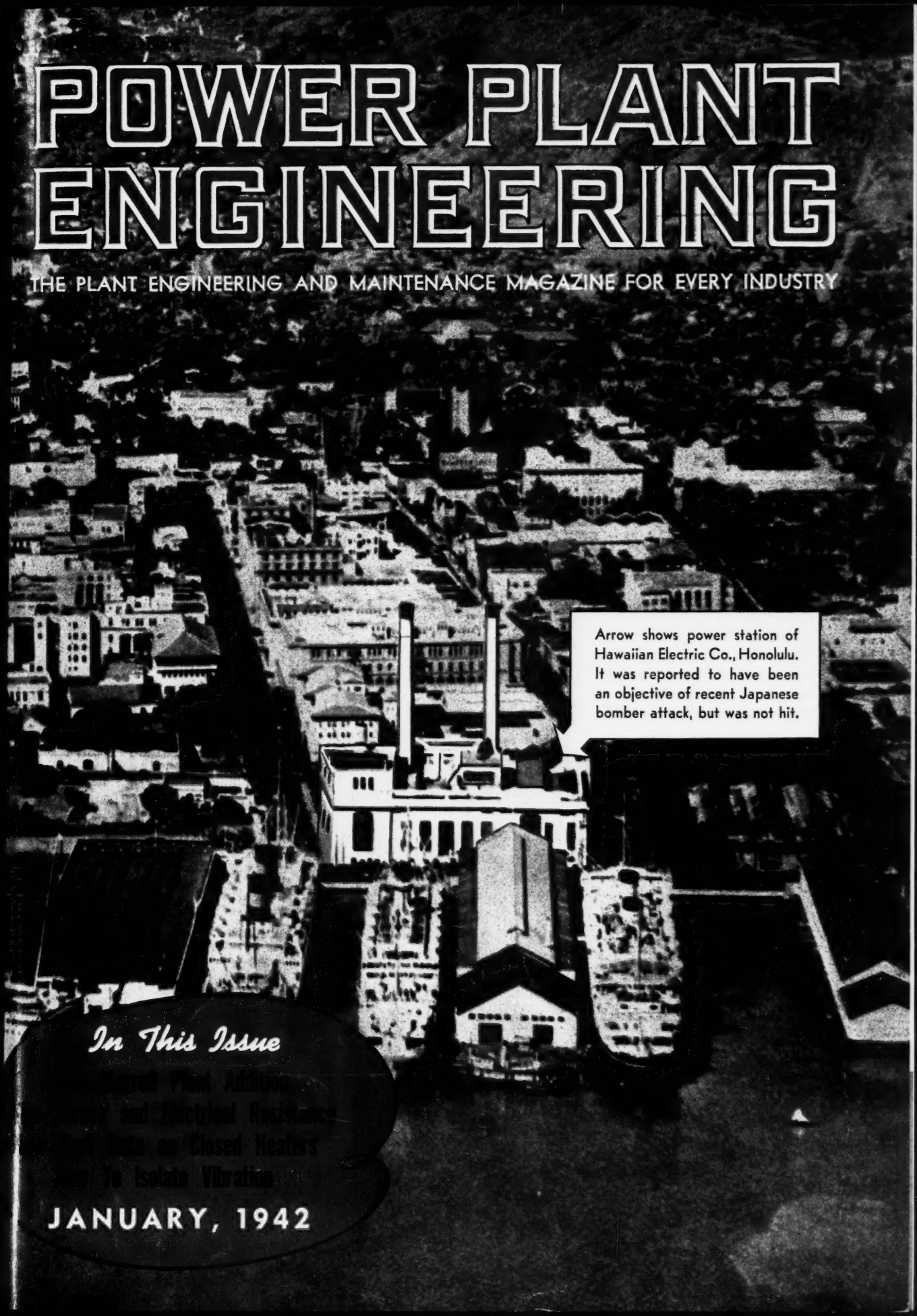
POWER PLANT ENGINEERING

THE PLANT ENGINEERING AND MAINTENANCE MAGAZINE FOR EVERY INDUSTRY



Arrow shows power station of Hawaiian Electric Co., Honolulu. It was reported to have been an objective of recent Japanese bomber attack, but was not hit.

In This Issue

Steam Plant Addition

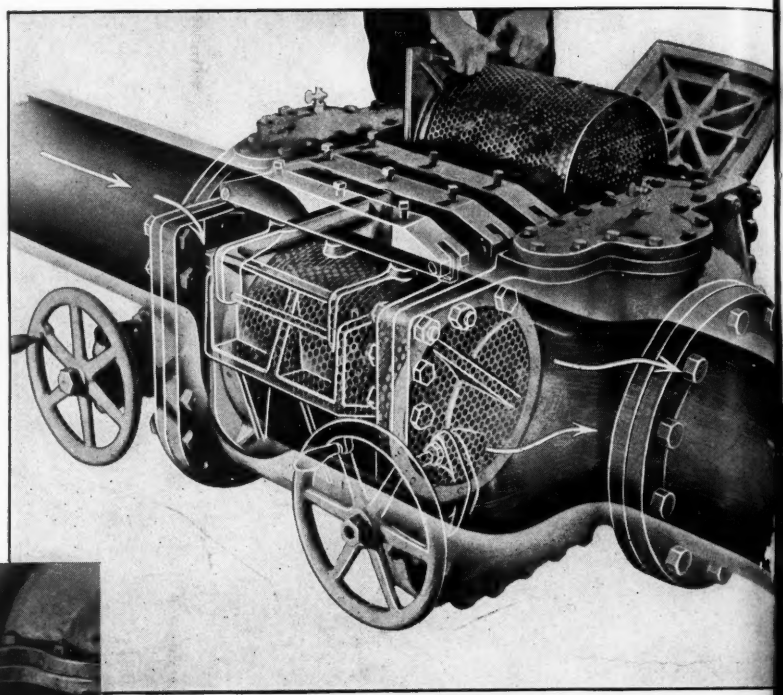
Resistance and Electrical Resistance

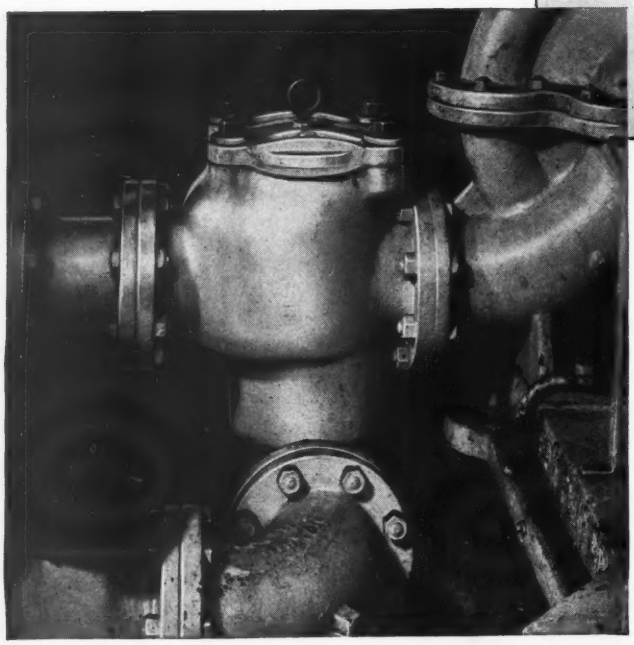
Test Data on Closed Heaters

How To Isolate Vibration

JANUARY, 1942

"CLEAR FOR ACTION wit





Twin Strainers, illustrated above, are cleaned simply and quickly without interruption of service. The operation of a valve at each end of the strainer diverts the flow to the alternate basket permitting fouled side to be opened and the basket removed for dumping. Strainer baskets may be supplied in any required mesh.

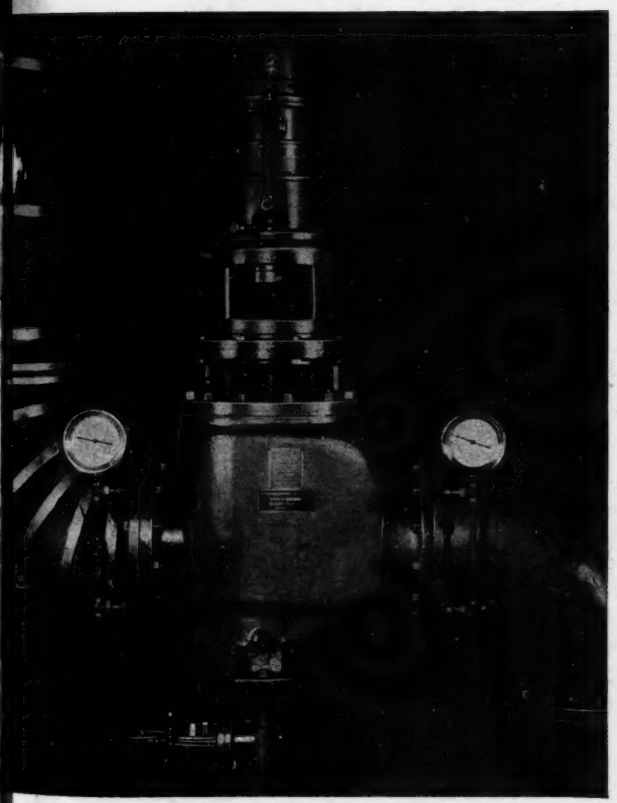
Single Strainer (shown at left) is sturdily built to meet all straining conditions in which occasional stoppage for cleaning may be allowed. Widely used and thoroughly dependable.

A single rotating element in bearings immune to abrasion, blanks out section after section of the straining element for backflushing in the Elliott Continuous Strainer (shown at the right). Strainer mesh is so constructed as to eliminate breakage and prevent matting of fibrous material. Used especially in clearing water of fine dirt, leaves or other substances.

ELLIOTT

ELLIOTT STRAINERS

CLEAR LIQUIDS FOR POSITIVE ACTION of pumps and liquid-handling apparatus . . . Remove foreign substances from oil, water or other liquid, so that pumps, condensers, burners, lubricators, process equipment, may function faultlessly, without hazard of stoppage or injury . . . To achieve this end, Elliott Strainers in various types are depended upon in power plants large and small, on land or at sea, in oil refineries, in industrial plants everywhere, safeguarding equipment, processes, and the quality and uniformity of manufactured products. More than a thousand Elliott Strainers are being used in the present shipbuilding program.



"Clear for Action"! is the watchword of Elliott Strainers. *Continuous* action, where the need requires, in Twin Strainers whose duplicate set of strainer baskets allows of cleaning the fouled basket without shutting off the flow; or in Continuous Self-cleaning Strainers, which flush themselves constantly without attention. Single Strainers too, where the service permits "time out" for cleaning.

Elliott is Strainer Headquarters — and has been for years. Tell us your straining problems.

A-268

COMPANY

ACCESSORIES DEPARTMENT
JEANNETTE, PA.
District Offices in Principal Cities

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STRAINERS • SEPARATORS • GREASE EXTRACTORS • NON-RETURN VALVES • LAGONDA-LIBERTY TUBE CLEANERS

Spends $13,000.00 — Gets it Back in

How a proposal that recommended the scrapping of two stokers in "good working order" resulted in an installation that's not only providing additional steam but also is paying for itself at a rapid pace

An Authentic Account of
COMBUSTION ENGINEERING
Service
(NO. 12 OF A SERIES)

Two years ago a manufacturer of oil industry equipment, who is now producing for the defense program, was obliged to replace his boilers which had been in service for 22 years. It was natural to ask C-E for quotations on exact duplicates of his existing equipment... two 350 hp Heine Boilers . . . which he expected to use over his present stokers.

Not satisfied merely to quote, as requested, the C-E sales engineer did some investigating and discovered that the maximum steam output obtainable from the present boilers was considerably less than it should have been. Further investigation by C-E engineers disclosed that the existing firing equipment was the bottleneck. Thereupon, C-E submitted an alternative proposal for a complete new unit consisting of a single larger boiler . . . VUZ Type with a Type E Stoker.

This job, to be sure, would cost $13,000.00 more than the simple replacement of the existing boilers. But what a difference! It would produce from 10,000 to 15,000 lb of additional steam per hr and operate at efficiencies which, conservatively calculated, could be expected to save $9,000.00 per year *in fuel alone.* Naturally, the customer accepted the C-E proposal.

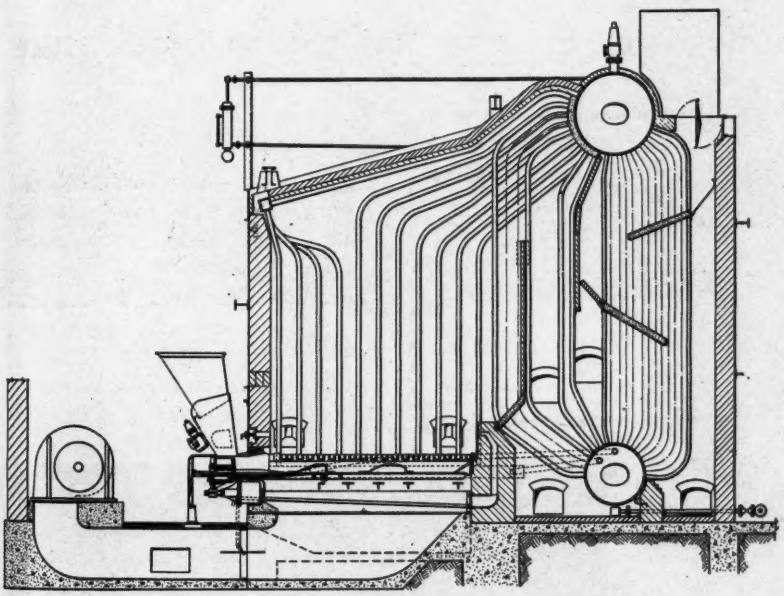
Today the installation has been in operation for about one year. The proportionate savings already are appreciably higher than the original C-E estimate. Hence, the difference in first cost will be paid off after slightly more than one year's operation. Moreover, at such a rate of savings, the entire installation cost will be paid for in another two to three years. All because of C-E's policy of rendering extra service . . . something more than is implied in the term "boiler manufacturer".

✱ *Original C-E estimate. Actual results much better. Will pay off in slightly more than a year.*

C-E PRODUCTS INCLUDE ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS, AND AIR HEATERS

COMBUSTION

MORE* 17 months ...for the right STEAM GENERATING EQUIPMENT



C-E

WHAT THIS MEANS TO YOU

The significance of this case history for you lies much deeper than any resemblance which it may bear to your steam generating problem. It serves to illustrate the extra values you may gain by discussing your requirements with C-E regardless of size or type of equipment. For C-E's wide experience includes every conceivable steam generating problem. By virtue of a policy that considers the customer's needs from every angle, C-E always seeks first the best economic solution to your particular needs. Then since C-E has the world's most complete line of steam generating and related equipment there are no obstacles to the fulfillment of the ideal installation to suit your conditions.

A-629

COMBUSTION ENGINEERING COMPANY, INC., 200 MADISON AVENUE, NEW YORK, N.Y. • CANADA: COMBUSTION ENGINEERING CORPORATION, LTD., MONTREAL

ENGINEERING

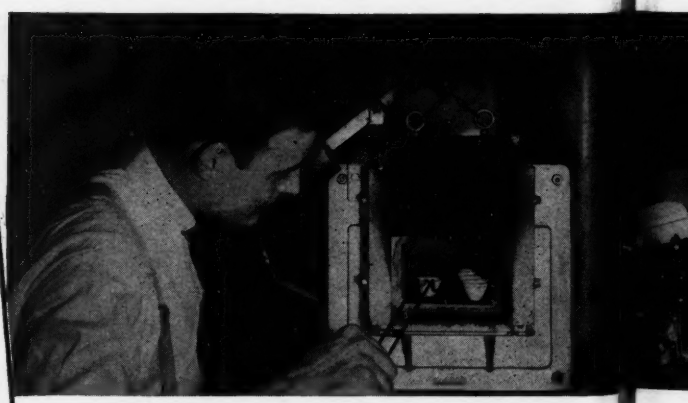
Published monthly by the Technical Publishing Co., at 58 West Jackson Blvd., Chicago, Ill., U. S. A. Subscription price, $2.00 a year. Single copies current issue, 25c. Entered as second class matter September 8, 1932, at the Post Office, Chicago, Ill., under act of March 3, 1879. Vol. XLVI, No. 1.

What caused the failure of this superheater tube?

DETAILS OF TUBE FAILURE: Tube evenly thin all around—thickness at bend approximately .076", as against .155" in straight section. Only one tube failed. No burning on furnace side except at localized failure. No furrowing or pitting on inside surface—no distortion—adherent scale paper-thin.

EXTERIOR BURNING?
CARRYOVER?
DEFECTIVE TUBE?
WATER CONDITIONING?

Here's how the answer was found...



CHEMICAL ANALYSIS: Main constituents of scale: magnetic iron oxide 63.5%, calcium oxide 21.1%, minor constituents: magnesium oxide 2.1%, silica 0.3%, carbon dioxide 2.8%; no evidence of phosphate.

ON the basis of the evidence presented, what *actually* caused the trouble?

Exterior Burning? No – because no other tubes showed any effect of localized high temperature, thinning was relatively even all around the failed tube, and the failure was very localized.

Carryover? No—because alkaline boiler water concentrating in a superheater develops high causticity and results in furrowing and pitting, not in *even* thinning. Furthermore, the quantity of bright magnetite crystals deposited by carryover is large—much larger than the very thin coating found in this case.

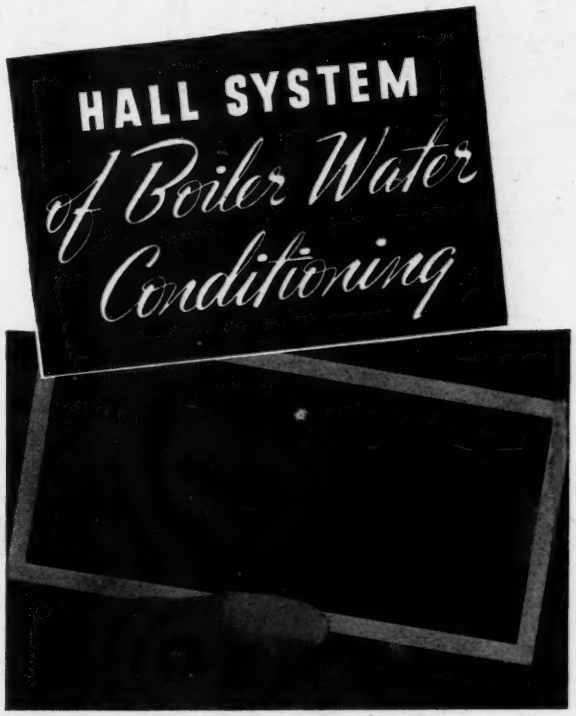
Water Conditioning? No – because no calcium phosphate was present. The thin deposit consisted mainly of magnetite and calcium hydroxide – caused by evaporation of treated water used for filling the superheater when the boiler was off the line.

Defective Tube? Yes! Thinness did not develop during operation, as proved by the even thickness of the tube circumference, by lack of distortion from round, and by uniform inside tube-diameter. Thinness developed in the drawing and bending of the tube. The defective condition was original—not caused by the incidents of operation.

• • •

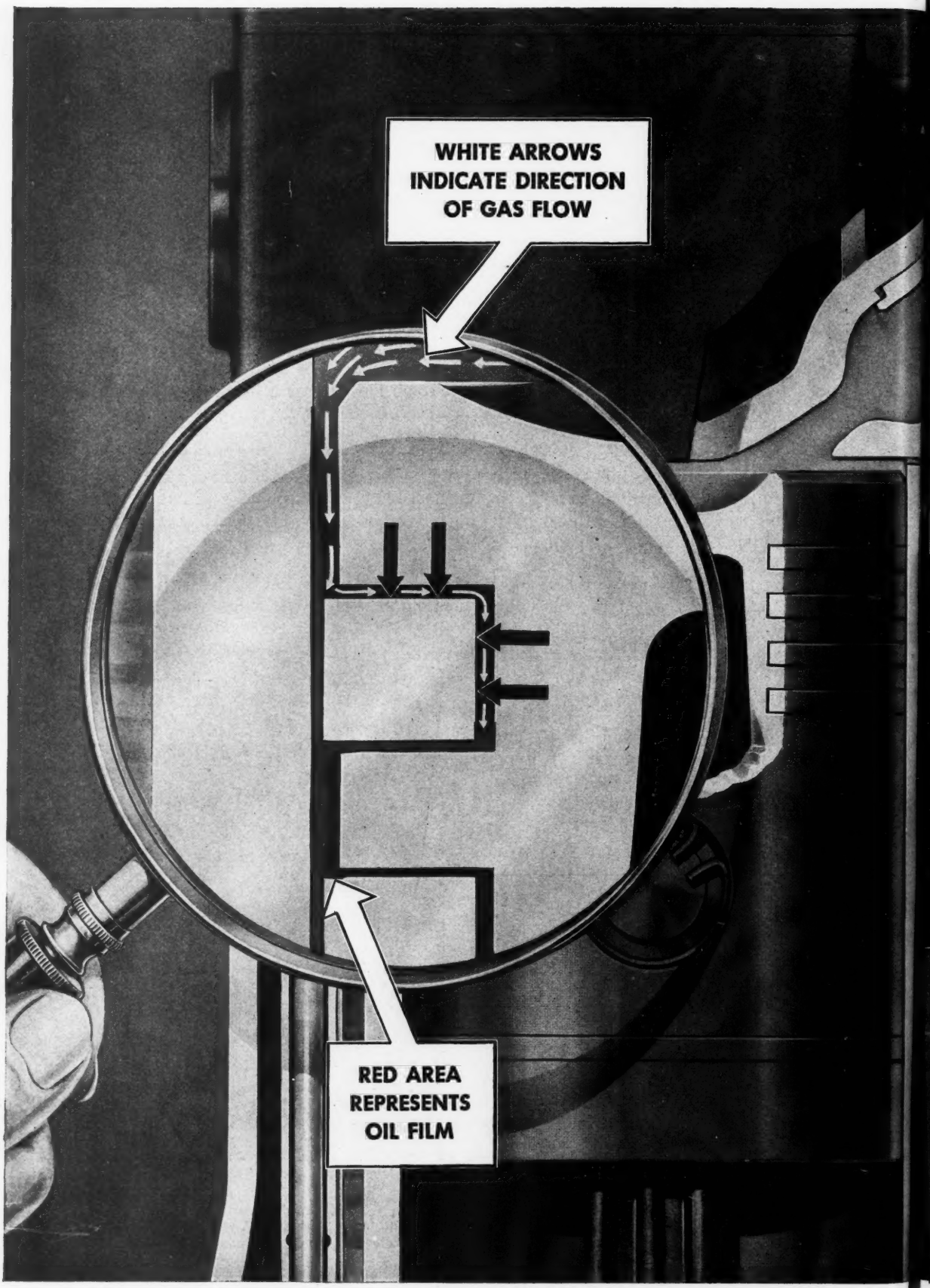
It may seem unusual for Hall Laboratories to search so carefully into the cause of such a relatively simple problem. But when the Hall report on *your* boiler problem arrives, you may be sure that *every* clue has been thoroughly investigated. That is why so many Hall System plants operate continuously *without* unscheduled outages – for years and years and years.

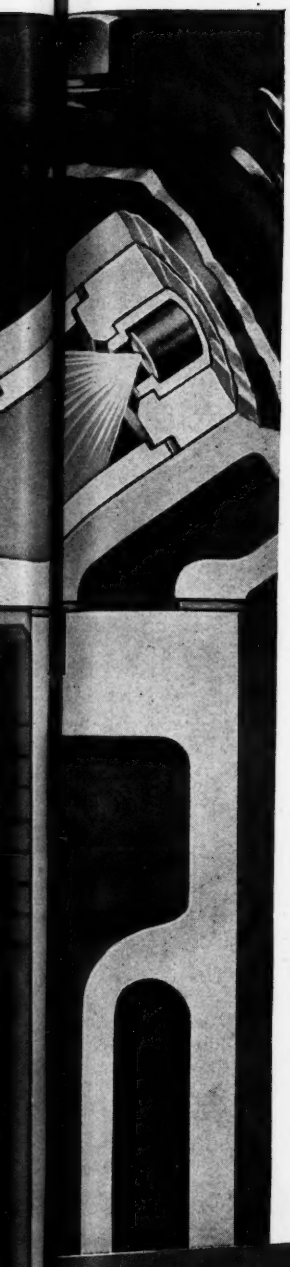
MICROSCOPIC EXAMINATION: Deposit analyzed principally as "black opaque octahedra of magnetite, with some blood-red transparent crystals of hematite and small amounts of calcite." Identification of other constituents rendered difficult by opacity of magnetite.



X-RAY ANALYSIS: Opacity is no screen for penetrating X-rays. Diffraction lines on X-ray film showed "finger prints" of magnetite and calcium hydroxide—no significant amount of any other crystalline constituent.

HALL LABORATORIES, INC. · 300 ROSS STREET · PITTSBURGH, PA.


WHITE ARROWS
INDICATE DIRECTION
OF GAS FLOW
RED AREA
REPRESENTS
OIL FILM



Defense Against A Flaming "Push"

THE "CORRECT" ANSWER TO A TOUGH PROBLEM IN DIESEL ENGINE OPERATION:

Problem: See those black arrows under the magnifying glass at the left? They show how the force of firing in a Diesel cylinder pushes against the top piston ring. That "push" may be stronger than 600 lbs. per sq. inch. Temperatures here are "very high." Under such conditions, costly wear and power-wasting "blow-by" may result—unless the cylinder and ring surfaces get *special* protection.

Answer: The *correct* lubricating oil is a defense against the "push" of the piston rings. It maintains a tough film on piston rings and cylinder walls. This film must not be ruptured by the crushing pressure. It must not oxidize to form ring-sticking deposits under the scorching heat.

Gargoyle D. T. E. Oils 1-to-5 are specially made to do this job in intermediate- and large-size Diesel engines.

Delvac 500 Series Oils are equally efficient for use in small, high-speed Diesels. And *Delvac 700 Series Oils* have been specifically approved by the Caterpillar Tractor Co. for the engines it builds.

TO HELP MAINTAIN CAPACITY PRODUCTION, CALL IN

SOCONY-VACUUM for "Correct Lubrication"

GARGOYLE Lubricants

SOCONY-VACUUM OIL CO., INC. — Standard Oil of N. Y. Div. — White Star Div. Lubrite Div. — Chicago Div. — White Eagle Div. — Wadhams Div. — Southeastern Div. (Baltimore) — Magnolia Petroleum Company — General Petroleum Corporation of Calif.

AMERICAN ENGINEERING

A-E-CO Taylor Stokers, Water Walls, Ash Hoppers, Hele-Shaw Fluid Power, Lo-Hed

BUT WHAT ABOUT "after"—?

Production!... Production!... Production!... Every ounce of energy ... every capacity for output is the crying demand of today ...

But some day there'll be a change! As far as a fuel firing system is concerned, it is important to consider today only that equipment which can operate at a maximum capacity over a long period and yet which can be reduced efficiently in the future —without using oil or gas to get down to low steaming rates.

Taylor Stokers offer you precisely that advantage for today—or tomorrow. You can vary capacity by a wide range on a Taylor Stoker without alteration of fuel. You can operate at minimum or maintain peak with comparatively little difference in horsepower and slagging. A minimum of power is diverted to unproductive auxiliary drives.

For this reason, and for many others, TODAY'S TREND IS TO TODAY'S TAYLOR STOKER! Investigate *all* the facts! With all the facts before you, decide then whether or not Taylor Stokers provide the most satisfactory "balance of power" requirements for your specific purpose. In increasing numbers, steam plant operators all over the country are turning to Taylor for efficient production today—and "after"!

**If you operate between 12,000 and 400,000 pounds of steam per hour or more, you are in the A-E-CO Area! You must carefully investigate and compare every advantage of today's Taylor Stoker with ANY other fuel burning equipment!*

SEND FOR FREE BULLETINS—giving facts on each of the 12 factors influencing economical, continuous steam generation. Indicates the "balance of power" requirements for your own plant. Write American Engineering Co., 2408 Aramingo Ave., Phila., Pa.

Use These 12 Factors as a "Check Chart" in Demanding FACTS About Any Fuel Firing Equipment

RELIABILITY The Taylor Stoker has a 35 year record of reliability of which 92.7% is typical.

CAPACITY Emergency reserve capacity is readily available over long periods of operation.

MAINTENANCE Average is 3.4c per ton based on a recent study of a typical group of plants.

FLEXIBILITY From 40,000 to 300,000 lbs/hr in 72 seconds. Cold boiler, no fire, to 250% rating in 20 minutes.

EFFICIENCY 16.73c for fuel per thousand pounds of steam is indication of A-E-CO Taylor Stoker "dollar" efficiency.

OPERATION Simplest of any. No complicated adjustments. Coal direct from mine to hopper.

ADAPTABILITY Modernization can be accomplished without seriously disturbing existing plant structure.

FUEL FLEXIBILITY Handles coals of widely varying characteristics; detailed list on request.

REFUSE DISPOSAL Choice of 3 methods; power dump, continuous and rotary.

STACK DISCHARGE 90% average of ash to ash pit. Dust-recovery equipment rarely used —even in heart of city locations.

SPACE REQUIREMENTS Conforms to short and wide, or long and narrow furnaces.

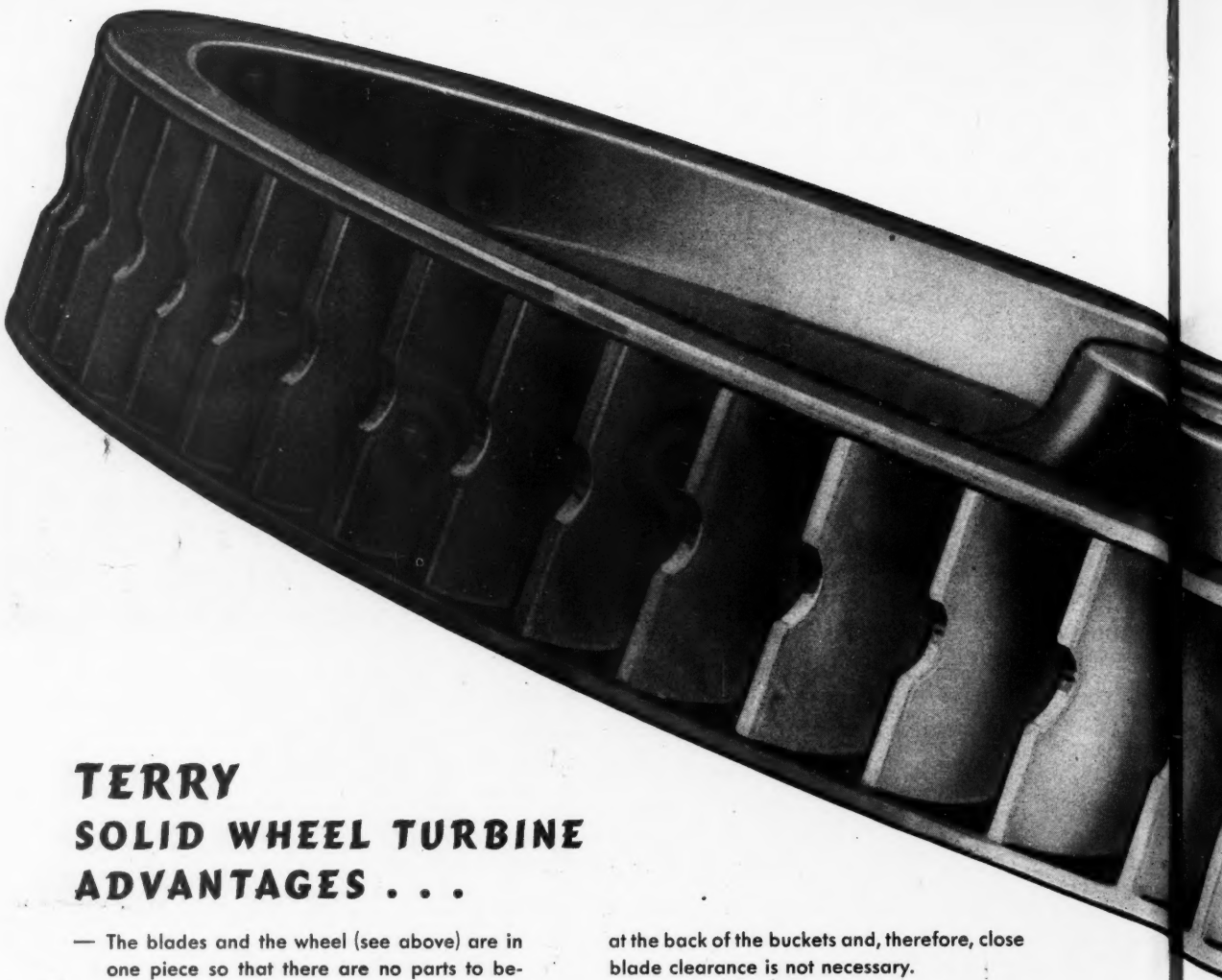
OBSOLESCENSE One basic design used for 35 years enables new improvements to be added to numerous existing installations.

THE A-E-CO Taylor Stoker

COMPANY

Hoists, Marine Deck Auxiliaries

The TERRY



TERRY
SOLID WHEEL TURBINE ADVANTAGES . . .

— The blades and the wheel (see above) are in one piece so that there are no parts to become loose or work out.

— The blades have large clearances.

— The blades are double run protected.

— End play will not damage the blading.

— It is impossible for the blades to foul.

— The power producing action of the steam in the wheel takes place on the curved surfaces at the back of the buckets and, therefore, close blade clearance is not necessary.

— As the only function of the blades is to form a series of pockets, wear of the blade edges is of little consequence and does not materially affect the horsepower or efficiency. The important part of the bucket is the back, or bottom, which is a solid forging.

— The Terry wheel will withstand abuse that would wreck any built up wheel.

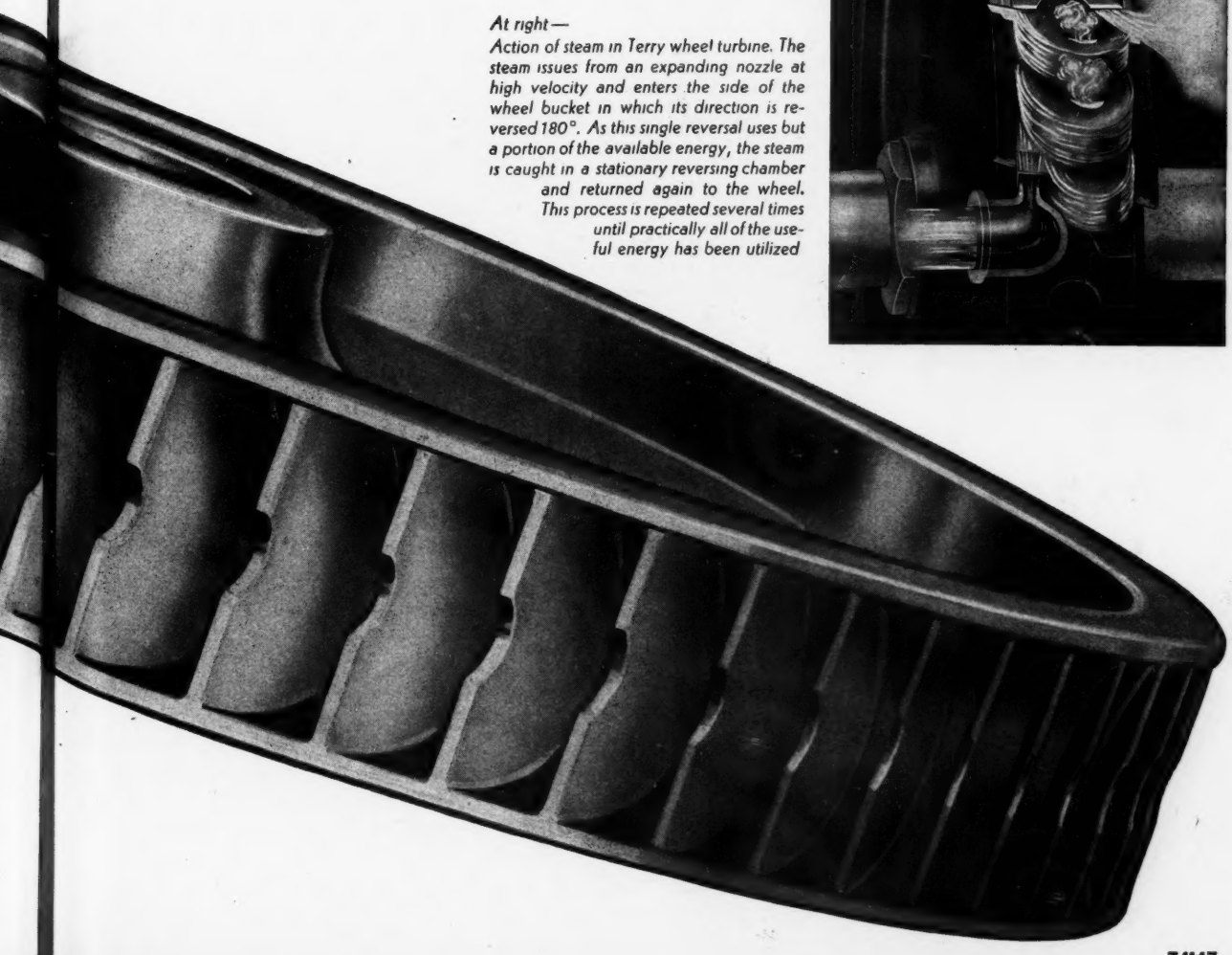
THE TERRY STEAM TURBINE CO.

Wheel Turbine

The Terry Solid Wheel Turbine is available in ratings from 5 HP to 2000 HP. It is built for all commercial steam pressures and exhaust pressures. Thousands of them are in daily service in central stations, industrial plants and on board naval vessels.

Full details of the Terry Solid Wheel Turbine will be gladly sent upon request. Ask for Bulletin S-116.

At right—
Action of steam in Terry wheel turbine. The steam issues from an expanding nozzle at high velocity and enters the side of the wheel bucket in which its direction is reversed 180°. As this single reversal uses but a portion of the available energy, the steam is caught in a stationary reversing chamber and returned again to the wheel. This process is repeated several times until practically all of the useful energy has been utilized



T-1147

TERRY SQUARE - HARTFORD, CONN.

The Tulip Time
Holland's tribute to the emigrants from the Netherlands who settled there in 1847.

This is one of two American Blower Induced Draft Fans functioning as a part of the modern equipment of the new James De Young electric power plant at Holland, Michigan. Many Holland industries are building for National Defense, and dependable electric power is vital.

A half-million visitors pilgrimage to Holland, Michigan, every Tulip Time, in May. They come to see the pageantry and color of the famous Tulip Time Festival. And invariably are impressed by the cleanliness, the beauty, the industrial and business activity in and about this "little bit of Holland."

Preponderantly Dutch in ancestry, the Holland population numbers 15,000. The city serves a trading area embracing 35,000 people. Two newspapers, two banks, thirty churches, no empty factories, popular resorts, and one of the lowest relief rolls in the country are among the assets the Chamber of Commerce enjoys boasting about.

Holland is proud, too, of the new James De Young electric generating station, completed in June, 1940. Built to meet the increasing demands of the 6,000 residential, commercial and industrial customers, the station has two 7,500 KWH generators. Further evidence of the foresighted planning behind this new, modern station are the American Blower Forced and Induced Draft Fans functioning in it. Perhaps you are now planning an improvement program calling for Mechanical Draft, Dust Precipitating or Fluid Drive (Hydraulic Coupling) equipment. May we have the privilege of serving you?

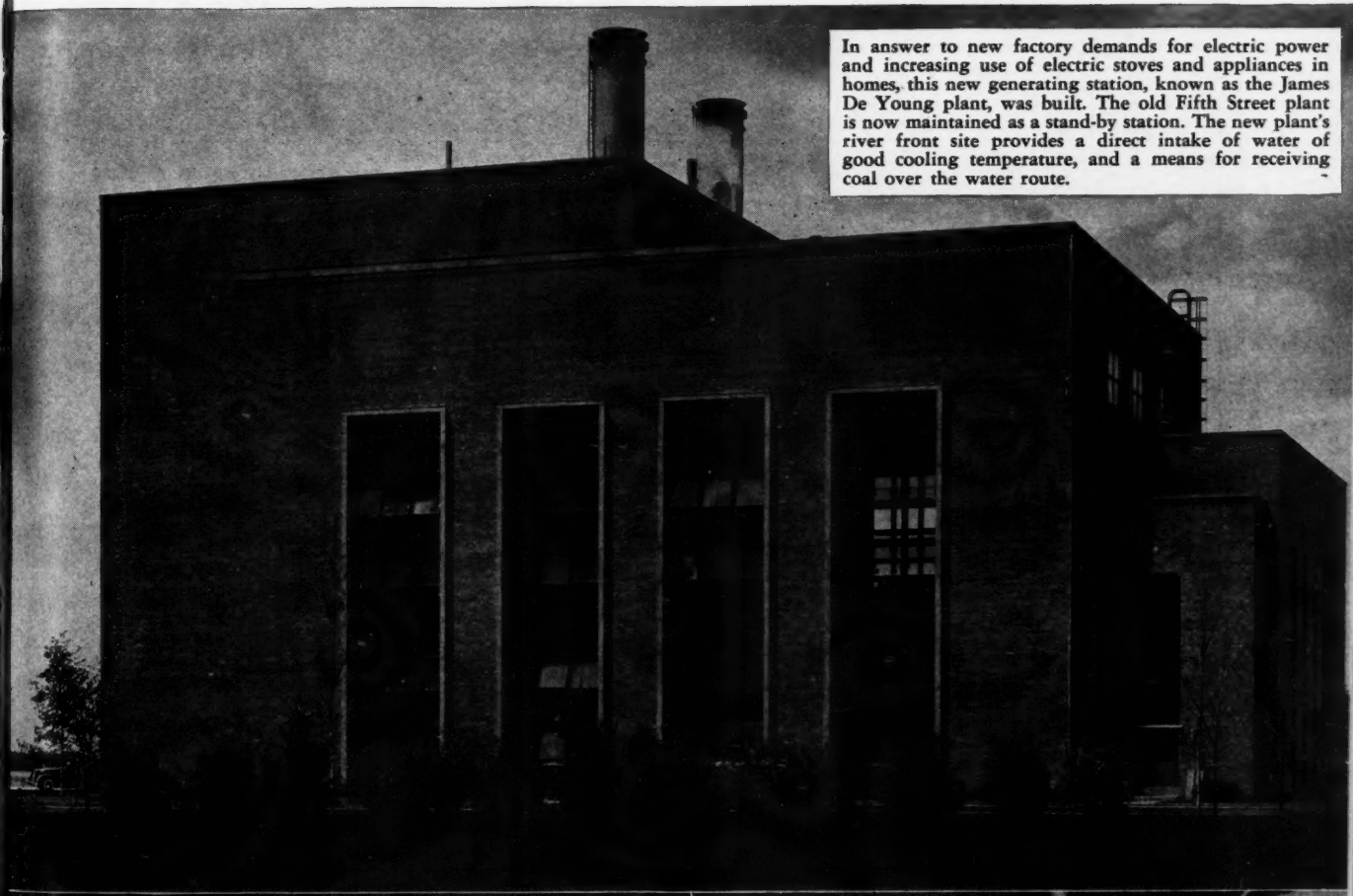
MECH. DRAFT · AIR-CONDITIONING
AMERICAN BLOWER
FLUID DRIVES · DUST COLLECTORS

AMERICAN BLOWER

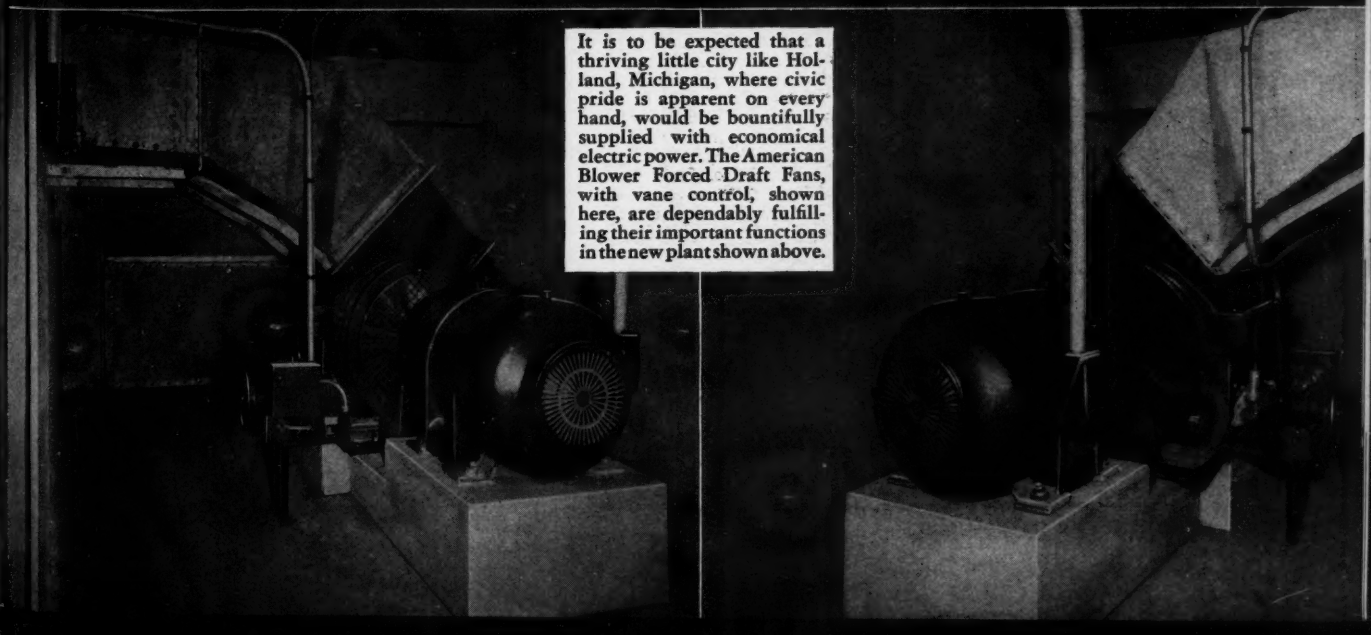
AMERICAN BLOWER CORPORATION, 6000 Russell Street, Detroit, Mich.
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONT.
Division of American Radiator and Standard Sanitary Corp.

Tulip Time

IN HOLLAND, MICH., EVERY YEAR IN MAY

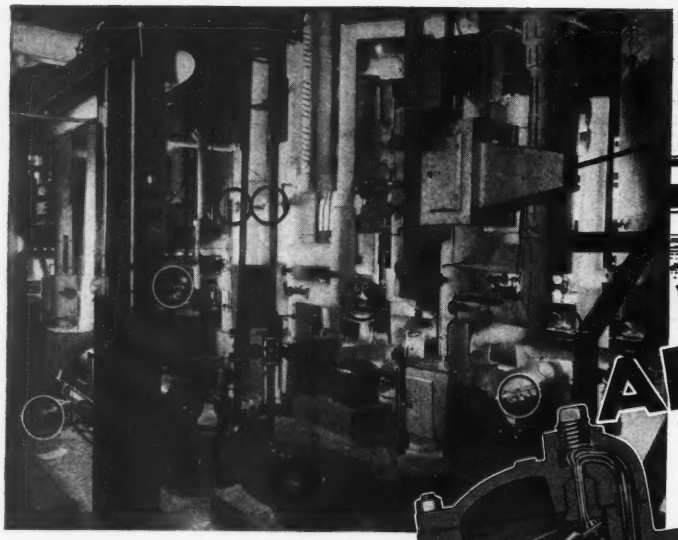


In answer to new factory demands for electric power and increasing use of electric stoves and appliances in homes, this new generating station, known as the James De Young plant, was built. The old Fifth Street plant is now maintained as a stand-by station. The new plant's river front site provides a direct intake of water of good cooling temperature, and a means for receiving coal over the water route.

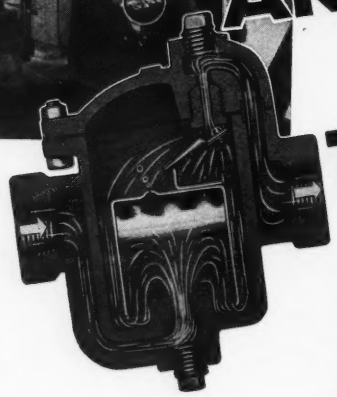


It is to be expected that a thriving little city like Holland, Michigan, where civic pride is apparent on every hand, would be bountifully supplied with economical electric power. The American Blower Forced Draft Fans, with vane control, shown here, are dependably fulfilling their important functions in the new plant shown above.

BOOST PLANT EFFICIENCY-



WITH ARMSTRONG "UNIT TRAPPING"



PICTURES IN THE NEW DUREZ PHENOL PLANT

THE accompanying pictures show the exterior and some of the interior equipment in the new $2,000,000.00 plant built by Durez Plastics & Chemicals, Inc., North Tonawanda, N. Y., to produce phenol by its revolutionary new vapor phase regenerative process. Mr. G. M. Loomis of the Durez organization advises that Armstrong traps, from the smallest to the largest, are used in this plant. Some of these traps are circled in the picture above. The No. 800 traps below offer a typical example of unit trapping in the Durez plant.

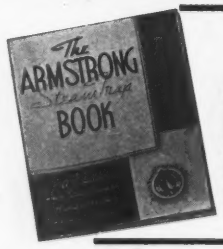
WHAT IT IS: Armstrong Unit Trapping is a practice approved by thousands of plant engineers. It consists of using an individual Armstrong steam trap of proper size on each separate steam coil, jacket, chest, and chamber.

WHAT IT DOES: Armstrong Unit Trapping (1) provides a positive pressure differential for each heating unit, thereby ending sluggish drainage, (2) provides an automatic valve for passing air, as well as water, thereby preventing formation of air pockets, (3) raises temperatures to correspond with steam pressure.

WHAT IT COSTS: Experience on actual installations has revealed that the installed cost runs little, if any more, than for a large single trap. Operating costs are lower and machine or coil temperatures are higher.

WHERE TO USE IT: A good way to check on whether you need Armstrong Unit Trapping is to take a surface pyrometer and look for units that are noticeably below steam temperature. (AND HERE'S A TIP: Watch for leaks of live steam into the return lines. They cost money and they raise back pressure.)

HOW TO APPLY IT: Armstrong has a whole book on how to apply the Unit Trapping System. Dozens of helpful suggestions. Write for a copy. Free, no obligation. ARMSTRONG MACHINE WORKS, 810 Maple St., Three Rivers, Mich.



EVERY PLANT ENGINEER WILL WANT A COPY OF THIS BOOK

Here is the well-known Armstrong Catalog and Educational Handbook on Condensate Drainage. This 36 page handy reference volume is a veritable encyclopedia of useful information about condensate drainage, heating, pipe sizes, hook-ups, and traps—profusely illustrated with photographs and diagrams and sprinkled with charts and tables. WE WILL BE GLAD TO MAIL YOU A COPY ON REQUEST AND WITHOUT OBLIGATING YOU IN ANY WAY.

DEFENSE FOR AMERICA'S STEAM!

For 1942 RIC-WIL offers to all users of underground steam the most dependable conduit systems ever developed. Over half a million lineal feet of RIC-WIL Pre-sealed Insulated Pipe Units have recently been required for government or government-directed projects alone. Since 1910, nearly *one thousand miles* of RIC-WIL Systems of *all types* have been installed.

With ample engineering and fabricated resources, RIC-WIL was READY when the call came, to implement the life lines of steam on any front. RIC-WIL is exceptionally well equipped for fast and large-scale production of all the different types of underground protection we manufacture. Defense requirements naturally come first. During this emergency, however, you may be assured that we will do our best to supply also, just as rapidly as possible, all demands from private sources.

For assurance of the finest in underground steam protection, now as always, it pays to insist on RIC-WIL!

RIC-WIL Insulated Pipe Units are a factory-built system, delivered to the job complete per plans and specifications, ready for installation . . . Thoroughly engineered for maximum efficiency, long life and strength . . . RIC-WIL Tile or Cast Iron Systems likewise guarantee to the user the highest efficiency, durability, and service performance ever available in these types of construction. RIC-WIL's famous patented Dry-paC Waterproof Asbestos Insulation, as well as various standard commercial insulating materials, or sectional pipe covering, are to be had with any type of RIC-WIL design . . . Ask for complete information and latest RIC-WIL Catalog.

RIC-WIL

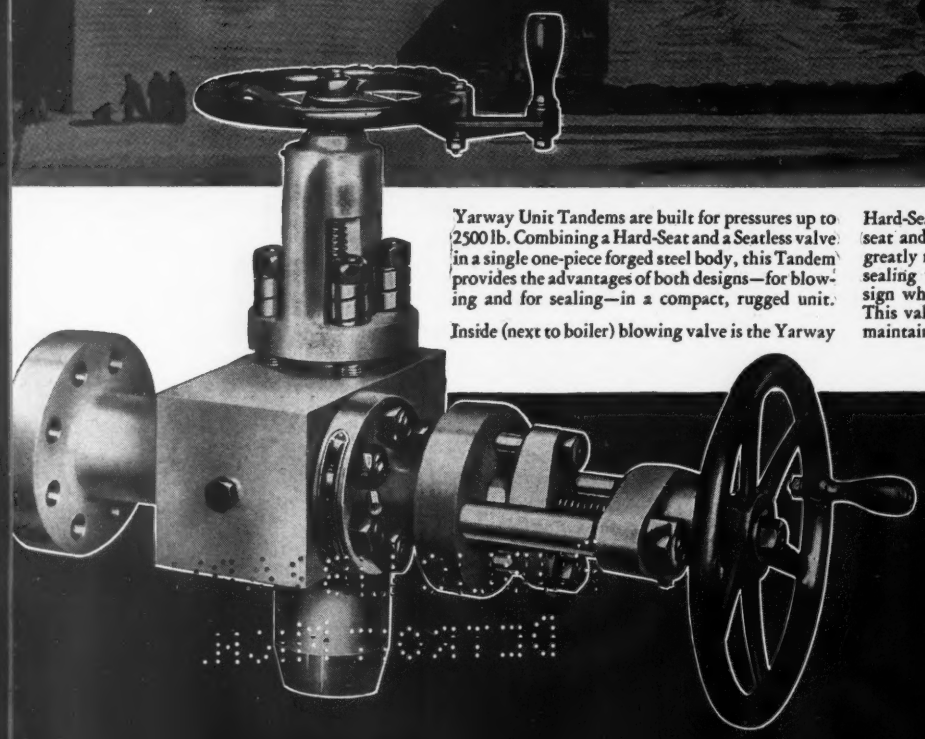
CONDUIT SYSTEMS FOR UNDERGROUND STEAM

THE RIC-WIL COMPANY • CLEVELAND, OHIO

AGENTS IN PRINCIPAL CITIES

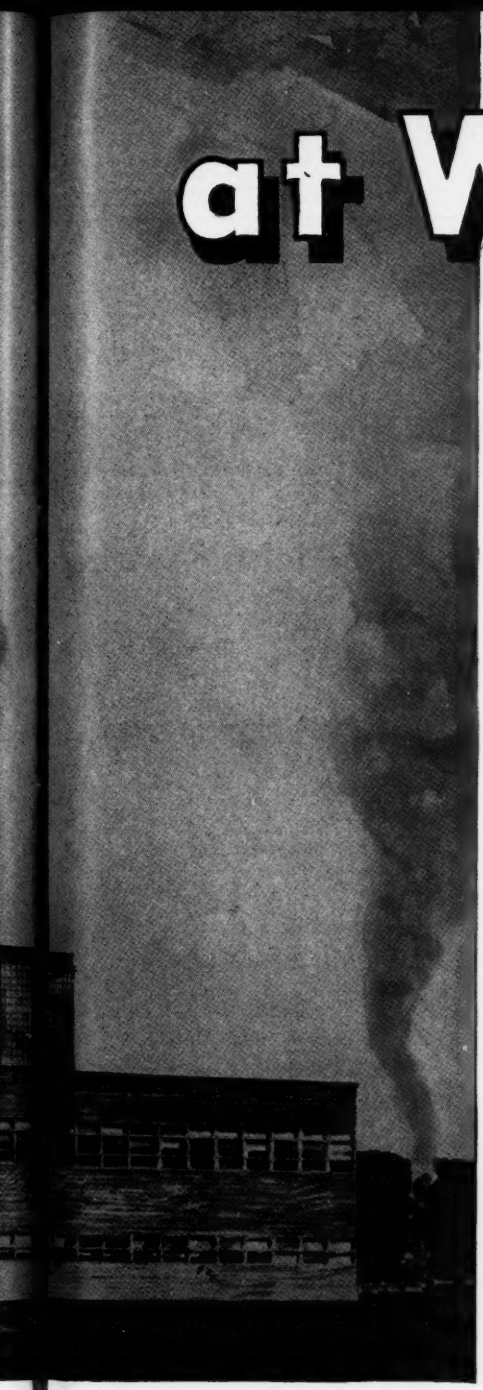
YARWAY

Watts Bar Steam Plant of the Tennessee Valley Authority, Spring City, Tennessee, supplements hydro-generated power to serve growing industry in the Southeast.



Yarway Unit Tandems are built for pressures up to 2500 lb. Combining a Hard-Seat and a Seatless valve in a single one-piece forged steel body, this Tandem provides the advantages of both designs—for blowing and for sealing—in a compact, rugged unit.

Inside (next to boiler) blowing valve is the Yarway Hard-Seat Valve which utilizes special Stellited seat and disc and unique construction features to greatly reduce wear in this type of valve. Outside sealing valve is the famous Yarway Seatless design which has no seat to score, wear and leak. This valve is always opened first and closed last, maintaining a tight seal.



at Watts Bar

TVA's amazing accomplishment in completing the first 120,000-KW section of the Watts Bar Steam Plant in eighteen months (ready to go on the line February, 1942) was possible through the use of simplified design and proved equipment which speeded construction and reduced preliminary operation to a minimum.

This 850-lb, 900 deg. F. steam plant, built to supplement hydro-generated power, will ultimately consist of four units when the last one goes into operation in October, 1942. All these boilers will be completely equipped with Yarway Unit Tandem Valves, equally suitable for blowing or draining—the dependable valve for high pressure service—the valve that has made such records as—"3000 blows at more than 1300 lb pressure, without replacement of a single part or repairs of any nature"—in the plants of leading utilities and industries.

There is a Yarway Blow-Off Valve for every pressure, purse and purpose. Write for Catalog; section B-421 for pressures up to 400 lb, section B-430 for pressures up to 2500 lb.

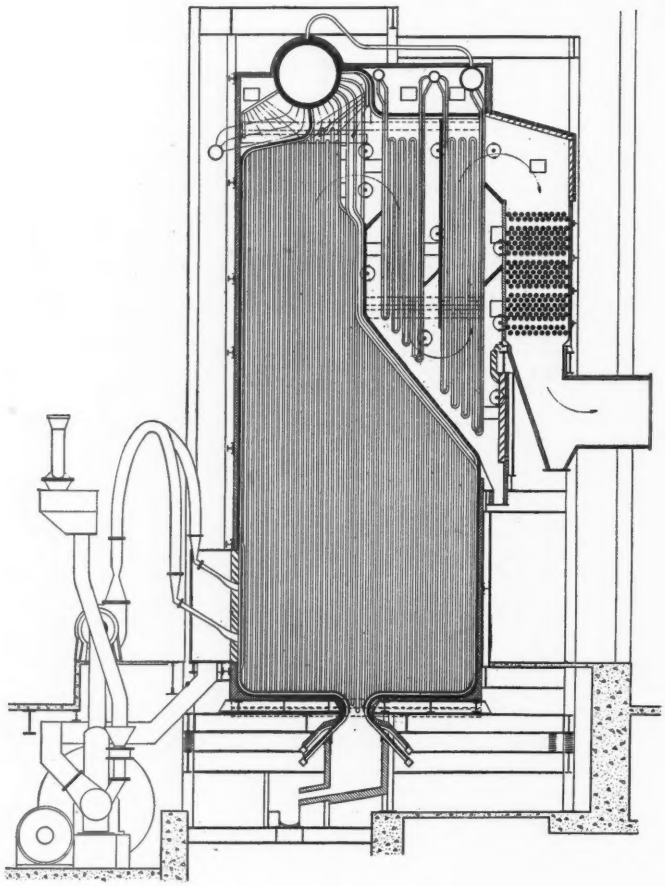
YARNALL-WARING COMPANY
114 Mermaid Ave. Philadelphia

YARWAY
BLOW-OFF VALVES

Two New Steam

COLUMBUS and SOUTHERN

The United Light & Power



WALNUT STREET STATION

Maximum Load

325,000 lb. per hour
1400 lb. per sq. in. pressure
900° F. final steam temp.
396° F. feedwater
85.11 efficiency

ONE PULVERIZER

Noteworthy features of this installation are the design and construction of Foster Wheeler slagging furnaces and the FW Hardinge type ball mills.

Foster Wheeler Corporation,

FOSTER

Generators for

OHIO ELECTRIC COMPANY

Service Company-Engineers

PICWAY STATION

Maximum Load

375,000 lb. per hour

900 lb. per sq. in. pressure

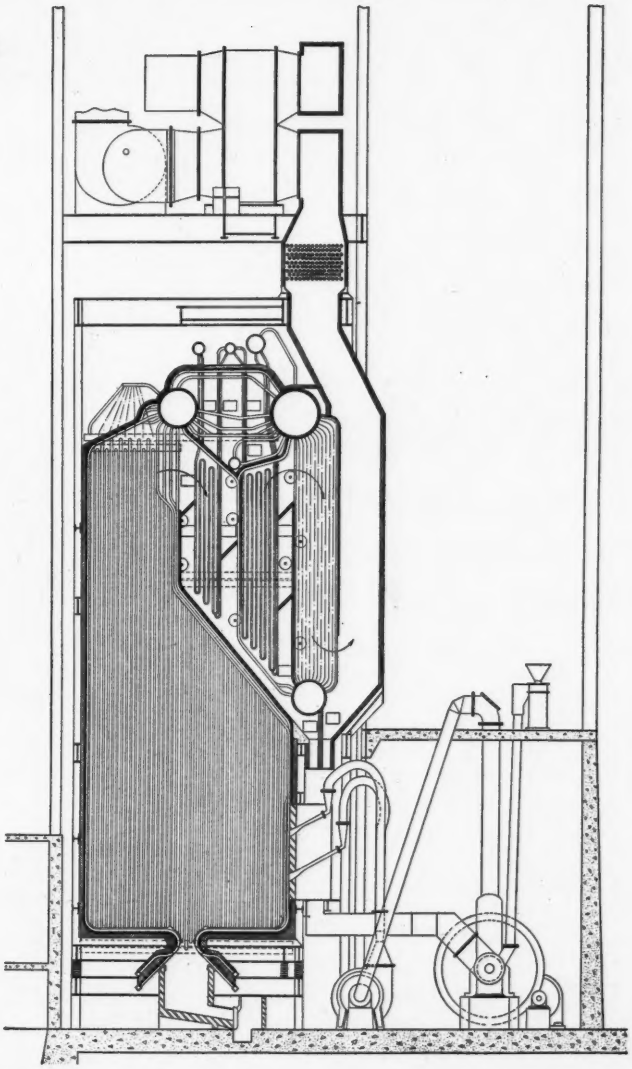
900° F. final steam temp.

400° F. feedwater

85.18 efficiency

ONE PULVERIZER

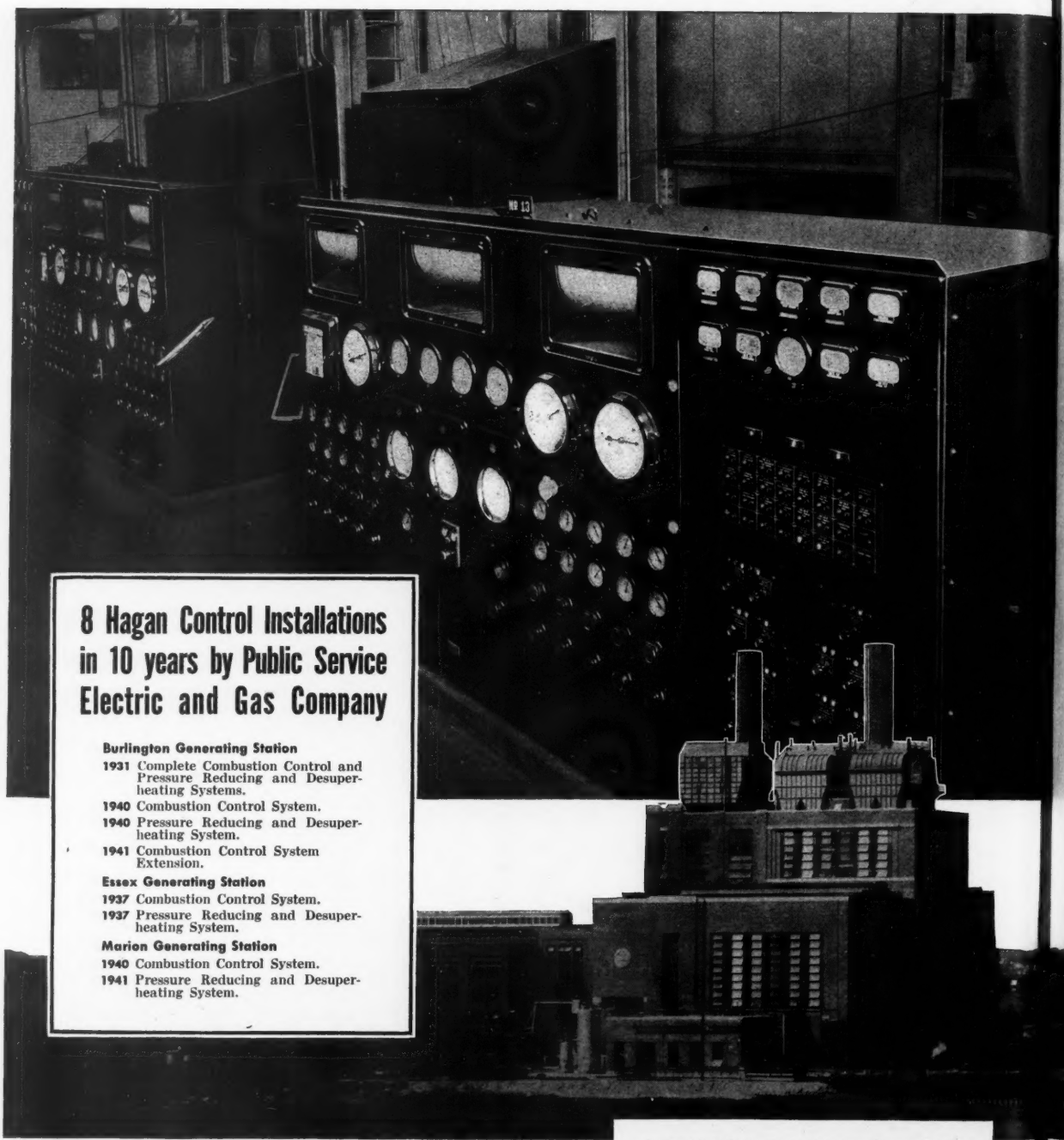
High pulverizer availability records of Foster Wheeler ball mills resulted in the installation of a single pulverizer per boiler.



165 Broadway, New York, N. Y.

WHEELER

Public Service Electric and Gas Company



8 Hagan Control Installations in 10 years by Public Service Electric and Gas Company

Burlington Generating Station

1931 Complete Combustion Control and Pressure Reducing and Desuperheating Systems.

1940 Combustion Control System.

1940 Pressure Reducing and Desuperheating System.

1941 Combustion Control System Extension.

Essex Generating Station

1937 Combustion Control System.

1937 Pressure Reducing and Desuperheating System.

Marion Generating Station

1940 Combustion Control System.

1941 Pressure Reducing and Desuperheating System.

THE BURLINGTON GENERATING STATION of Public Service Electric and Gas Company, New Jersey. Three Hagan Automatic Combustion Control installations have been made in Burlington Generating Station since 1931. These systems control boilers operating at 650 and 1350 pounds per square inch pressure.

No matter what the type, any boiler can be equipped advantageously with Hagan Control.

REORDERS HAGAN CONTROL SEVEN TIMES IN FOUR YEARS

New high efficiencies obtained by enlarged Burlington, Essex and Marion Generating Stations

PUBLIC Service Electric and Gas Company, Newark, N. J., has enlarged three of its five generating stations since 1937, installing new units in Burlington, Essex and Marion Generating Stations.

Because of the splendid results and reliable performance obtained with an original installation of Hagan Automatic Combustion Control in the Burlington Generating Station in 1931, *fully automatic* Hagan equipment was ordered for all three stations when the new additions were made.

When increasing power demands necessitated further expansion, Hagan Control was reordered to establish *fully automatic,* complete control in each station.

Despite this rapid and extensive growth, power was generated *when, where* and *as* needed, without interruptions, at new *high efficiencies.*

Combustion control is not entirely responsible for increased efficiency, but consider the matter on a reorder basis. Certainly *one* measure of excellence in a combustion control system is its *reorder* record among important users. In this case, *one* good job led not to another, but to *seven* additional jobs.

Similar records are common with Hagan Automatic Combustion Control. Reorders are built into *every* job. Every installation is designed to fit the *particular* job required, to *do* the job right, automatically, and to *keep* doing it right for years.

When planning an extension or a new control installation, it is wise to look first at the leader, for a *genuine* measure of value. It is even wiser to stop right there, for Hagan Control will cost less and give you greater satisfaction in the long run—and that is what counts.

Advantages of **HAGAN**
AUTOMATIC COMBUSTION CONTROL

INCREASED EFFICIENCY through correct proportioning of fuel and air.
CONSTANT STEAM PRESSURE.
EVEN DISTRIBUTION OF LOAD among boilers, or division as desired.
MAXIMUM STEAM OUTPUT per pound of coal.
MAXIMUM EFFICIENCY with minimum supervision.
FAST, RELIABLE OPERATION without hunting.
SIMPLICITY and ease of installation.
ELIMINATION OF SMOKE.
LOWER POWER COSTS.
THE ENGINEERING EXPERIENCE *of the pioneers in automatic combustion control.*

HAGAN CORPORATION • 300 ROSS STREET • PITTSBURGH, PA.

HAGAN *Automatic* COMBUSTION CONTROL
The pioneer . . . and still the leader

TRI CLAD moves

REG. U.S. PAT. OFF.

THREE "EXTRA PROTECTION" FEATURES GIVE EVERY TRI CLAD MOTOR GREATER STRENGTH AND LONGER LIFE

1 *Extra Protection* against physical damage

2 *Extra Protection* against electrical breakdown

3 *Extra Protection* against operating wear and tear

ARMORED CONSTRUCTION . . . SMOOTH CONTOURS . . . RIGID ALIGNMENT

Strong, one-piece, cast-iron frame and cast end shields, with upper portion completely enclosed, protect vital motor parts from external blows, falling objects, or dripping liquids. There's less chance of damage in installation, or in operation under "slam-bang" conditions.

"FORMEX" WINDINGS . . . BONDED COIL UNITS

Stator windings of Formex wire give extra protection against moisture oil, abrasion, and heat-shock. New synthetic-resin bonding varnish and Glyptal No. 1201 Red on end-turns add to durability. You can count on uninterrupted performance and long life under strenuous conditions.

NEW BEARING DESIGN . . . ONE-PIECE, DYNAMICALLY BALANCED ROTOR

Sleeve bearings proportioned and grooved for protective lubrication under severe loads. Sleeve and ball bearings enclosed in strong, dust-tight housings. One piece rotor, with fans cast integrally, has new electrical and mechanical features assuring smooth, cool operation and high efficiency.

GENERAL ELECTRIC COMPANY, SCHENECTADY, N. Y.

BUILT FOR PROTECTION FIRST . . . TO LAST!

up!

NOW . . . . .

TRI CLAD polyphase induction motors are available in integral-hp sizes through . . . . 75 hp

75 hp
60 hp
50 hp
40 hp
30 hp
25 hp
20 hp
15 hp
10 hp
7½ hp
5 hp
3 hp
2 hp
1½ hp
1 hp

. . . a LARGER range of sizes!

. . . a WIDER scope of service!

The advanced design and triple-tough construction that won industry's enthusiastic acceptance almost overnight have now been extended to many larger motors in our a-c line.

General Electric and its employees are proud of the Navy award of Excellence made to its Erie Works for the manufacture of naval ordnance.

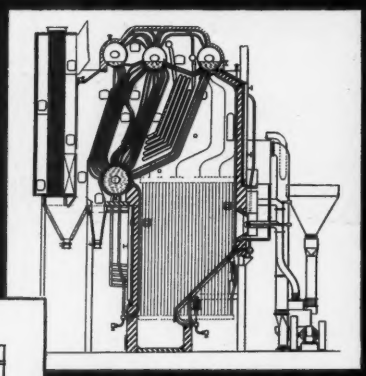
GENERAL ELECTRIC

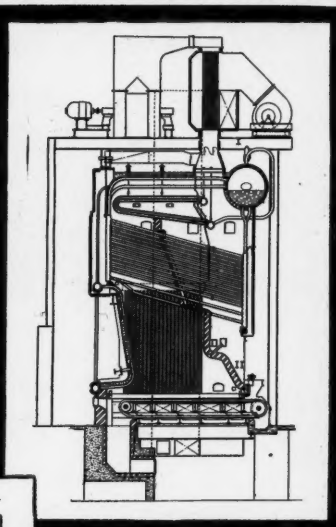
750-104-8058

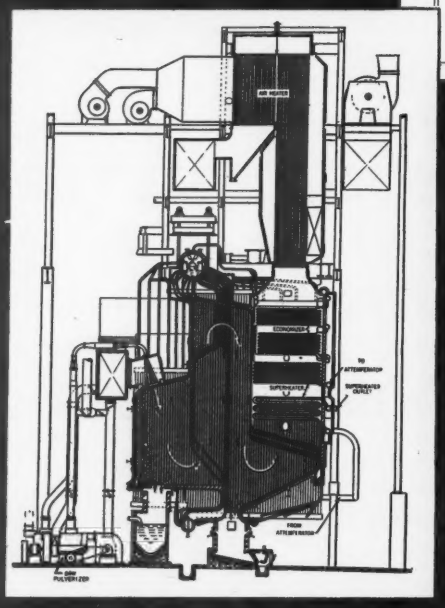
The fundamental soundness of B&W designs has been proved repeatedly in actual service under a wide range of operating conditions. Unequalled experience in the fabrication of boilers and related equipment, as well as pioneering and progressive engineering, have been responsible for B&W's ability to anticipate and to meet promptly the needs of modern power plants.

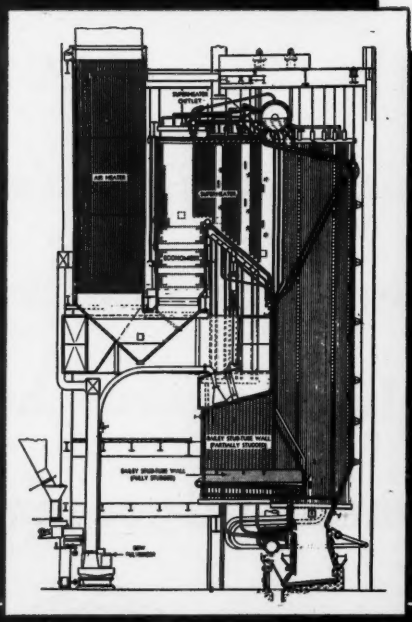
Bulletins describing Babcock & Wilcox Boilers and component equipment are available on request.

B&W



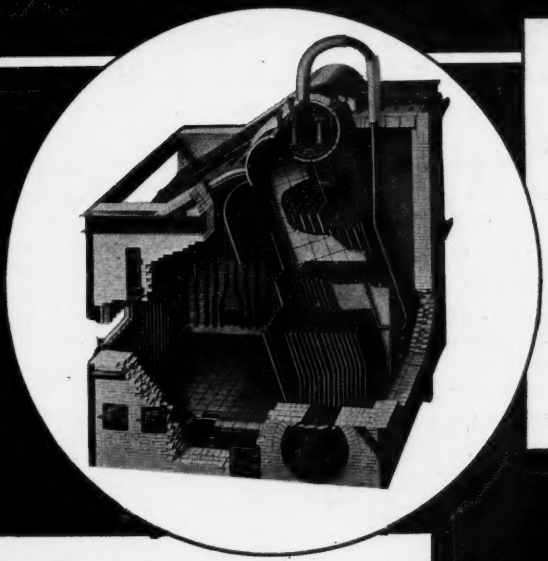


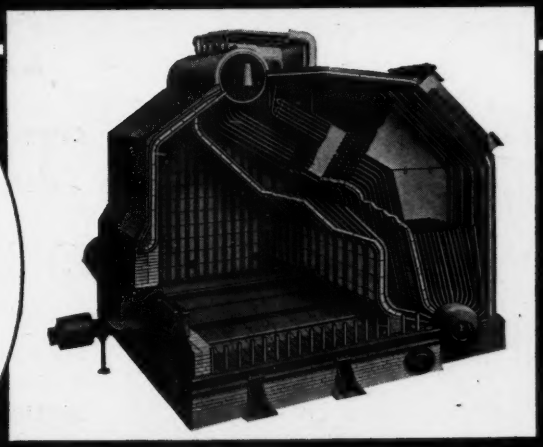


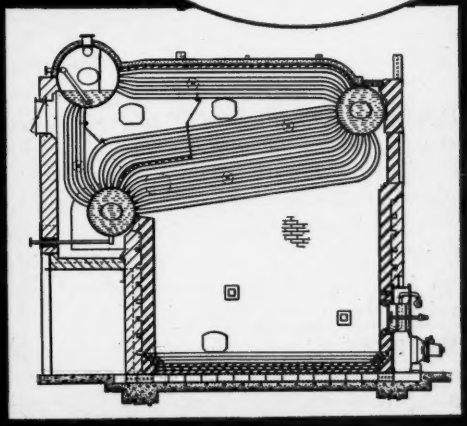


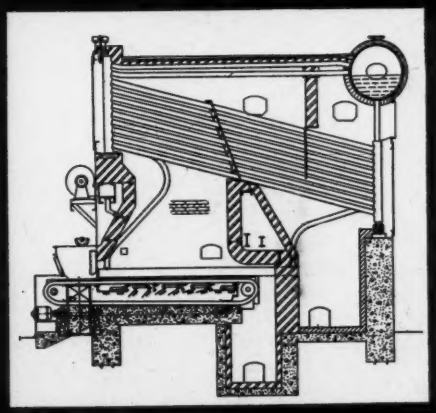
BABCOCK &

anticipates and meets



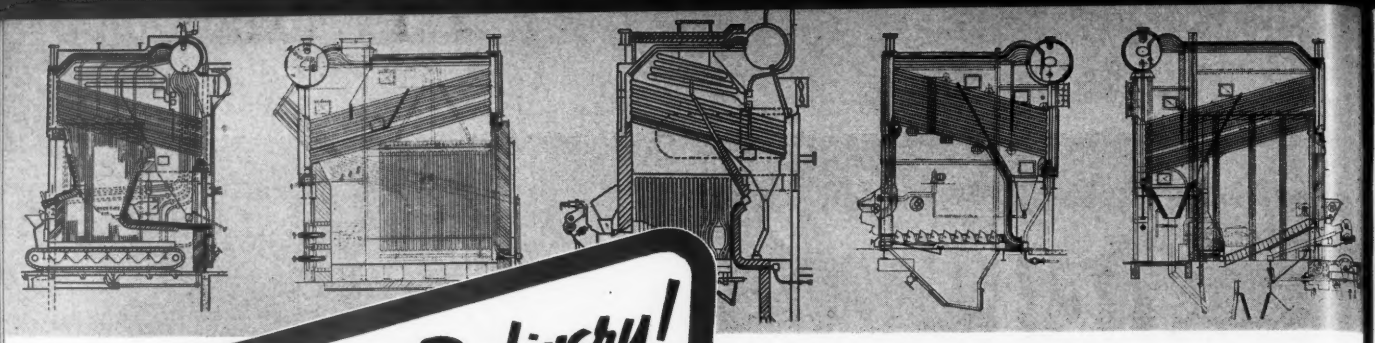






& WILCOX

G-215 F



Get Earlier Delivery!
Cut Costs!
Conserve Metals!

WITH A SPRINGFIELD "Duplicate" Unit

ORGANIZATIONS engaged in defense projects, or otherwise able to obtain priority ratings, can get quicker delivery . . . save money . . . and aid in conserving metals on steam plant requirements by taking advantage of the distinctive construction features of Springfield straight tube, cross drum, sectional header boilers.

DUPLICATE UNITS. Complete drawings, patterns, shop fixtures, etc., are on hand to duplicate any of the many modern Springfield steam generating units built in recent years. Capacities from 5000 lbs. to 450,000 lbs. per hour, or more. Pressures from 75 lbs. to 750 lbs., or higher.

SINGLE DRUM. A minimum amount of steel plate is diverted from shipbuilding and other urgent uses when the Springfield design is used.

SECTIONAL CONSTRUCTION. Sections of 3" tubes rolled into rugged electric cast steel headers are assembled complete with baffles in our shop saving weeks or months in field construction time, depending on the size of the units. Water walls are also shop assembled where field conditions permit.

STRAIGHT TUBES. With one size of straight tube, Springfield averages about 1/16 fewer tube sizes than common bent tube boilers which means less delay in securing materials.

RADIANT HEAT FURNACES. Springfield pioneered water walls in America. Heavy duty designs are now available for general industrial service that permit safe operation at higher ratings—more steam per pound of metal! These water walls are also being applied to existing boiler installations as a means of greatly increasing capacity at minimum cost.

COMPLETE UNITS. Springfield regularly takes contracts for complete steam generating units. Write, phone, or wire for quotations. SPRINGFIELD BOILER CO., 1951 E. Capitol Ave., Springfield, Ill.

SPRINGFIELD

STEAM GENERATING UNITS

SPRINGFIELD BOILERS

ANY SIZE ANY FUEL ANY PRESSURE

HAVE YOUR BOILERS EQUIPPED WITH ERNST

"SPLIT-GLAND"

ADJUSTABLE WATER GAGES

They can be attached to any make of water column or boiler

FOR ALL PRESSURES

GAGES CAN BE SET AT ANY ANGLE OR VERTICAL

NO GAGE GLASS PACKING NUTS

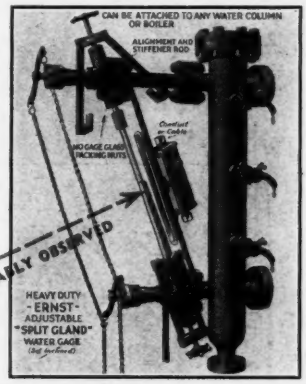
No Tools Required to Change A Gage Glass

WATER LEVEL VISIBLE FROM BELOW

MOST IMPORTANT of the boiler attachments is THE WATER GAGE

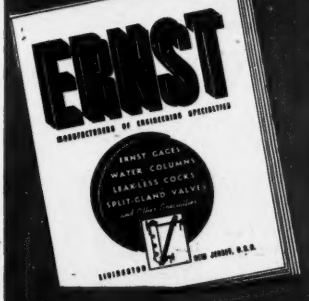
For steam pressures above 500 lbs. we recommend ERNST Flat Gage Glass Inserts with "SPLIT-GLAND" GAGES.

The Ernst improved Illuminator gives a bright RED reflection of the water. (No special red line glasses required.) No hoods or other complicated devices. Nothing to get out of order.



THE ORIGINAL WATER LEVEL CAN BE PLAINLY AND RELIABLY OBSERVED

ASK FOR BOILER CATALOG NO. 45



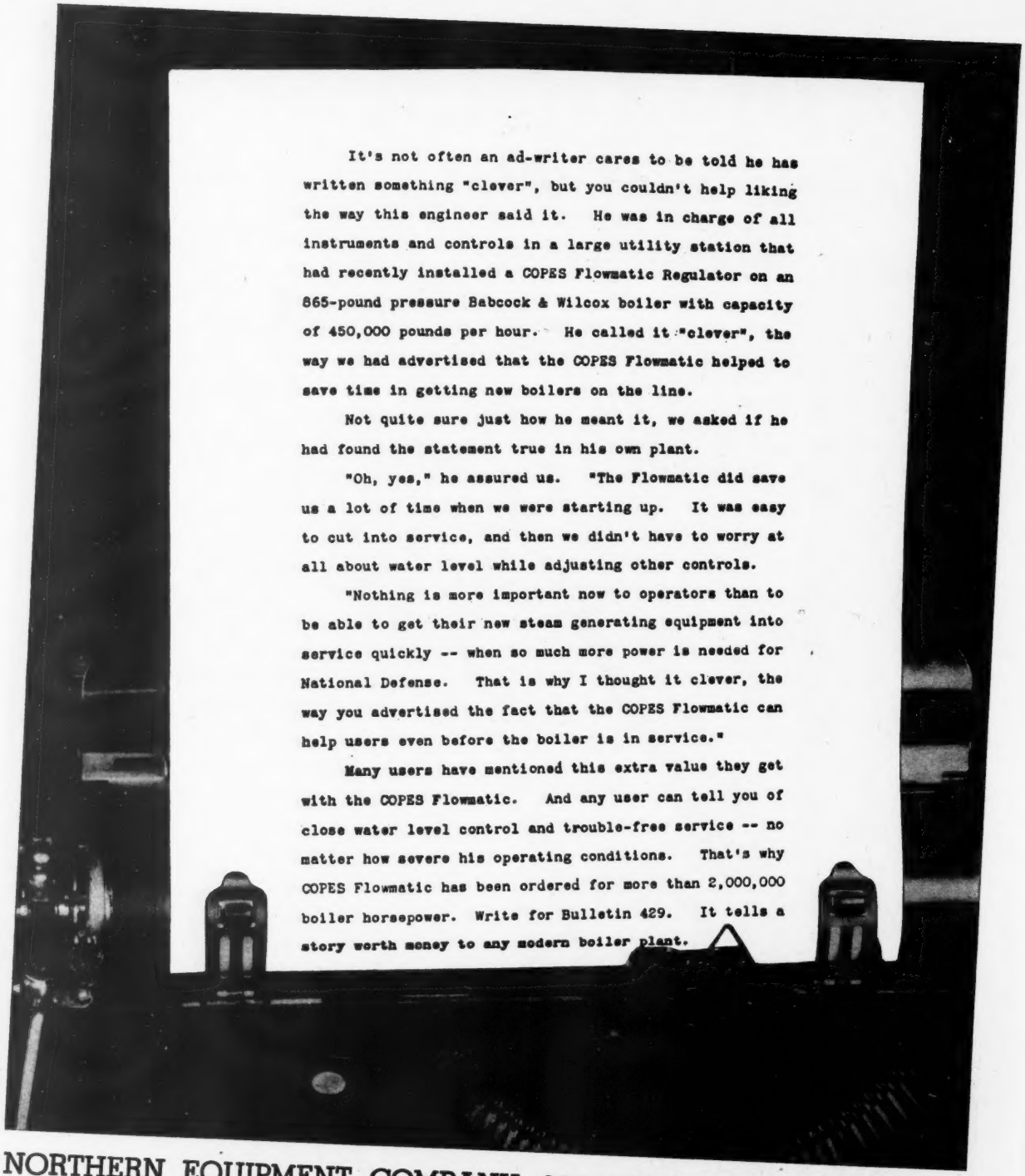
For Safety "Better-C" the ORIGINAL Water Level Ernst

How to specify "SPLIT-GLAND" *Column for your next project*

Each boiler to be equipped with Ernst Water Columns suitable for ..... pounds working pressure and each Column to be furnished with Split-Gland Adjustable Water Gage Fittings and Leakless Super Try Cocks. Gage Glass Guards and C-Red Illuminators are to be furnished, and sufficient rust-proof chain to operate Gages and Try Cocks from boiler room floor.

All material as manufactured by Ernst Water Column & Gage Co., Livingston, N. J.

ERNST WATER COLUMN & GAGE CO., LIVINGSTON, NEW JERSEY



It's not often an ad-writer cares to be told he has written something "clever", but you couldn't help liking the way this engineer said it. He was in charge of all instruments and controls in a large utility station that had recently installed a COPES Flowmatic Regulator on an 865-pound pressure Babcock & Wilcox boiler with capacity of 450,000 pounds per hour. He called it "clever", the way we had advertised that the COPES Flowmatic helped to save time in getting new boilers on the line.

Not quite sure just how he meant it, we asked if he had found the statement true in his own plant.

"Oh, yes," he assured us. "The Flowmatic did save us a lot of time when we were starting up. It was easy to cut into service, and then we didn't have to worry at all about water level while adjusting other controls.

"Nothing is more important now to operators than to be able to get their new steam generating equipment into service quickly -- when so much more power is needed for National Defense. That is why I thought it clever, the way you advertised the fact that the COPES Flowmatic can help users even before the boiler is in service."

Many users have mentioned this extra value they get with the COPES Flowmatic. And any user can tell you of close water level control and trouble-free service -- no matter how severe his operating conditions. That's why COPES Flowmatic has been ordered for more than 2,000,000 boiler horsepower. Write for Bulletin 429. It tells a story worth money to any modern boiler plant.

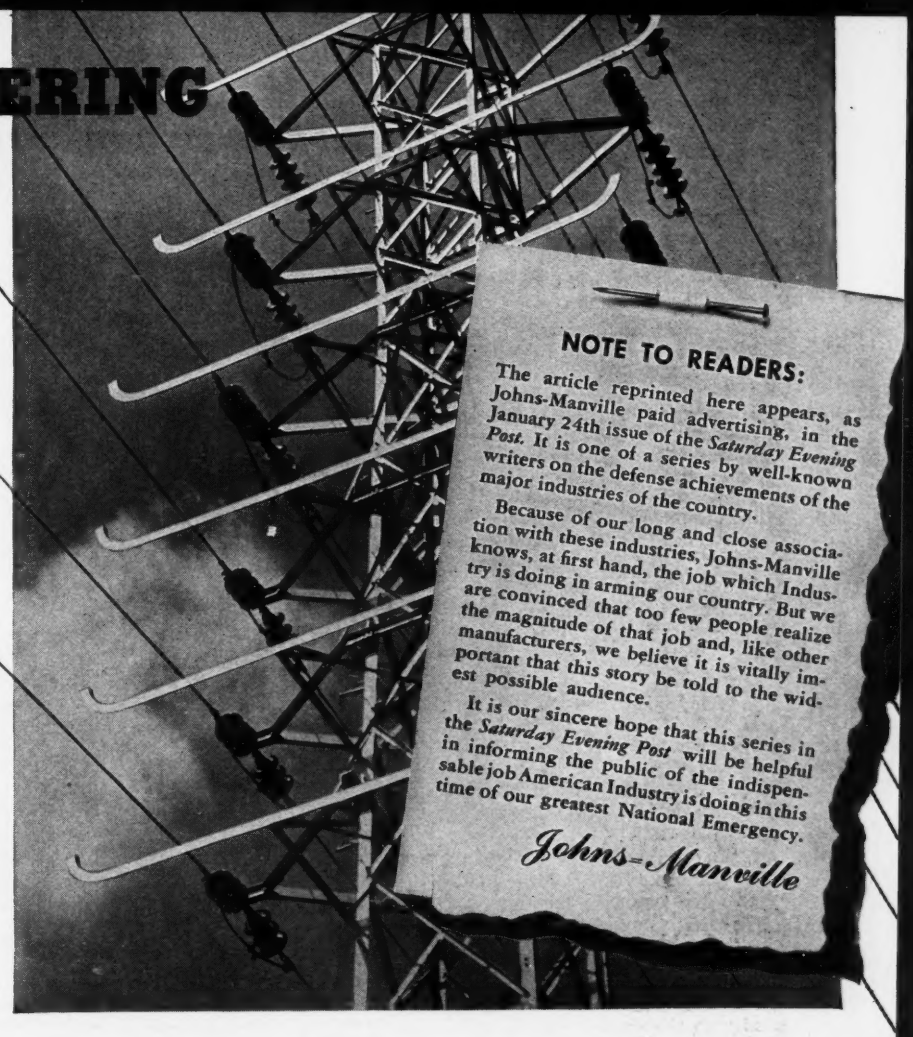
NORTHERN EQUIPMENT COMPANY, 122 GROVE DRIVE, ERIE, PA.

★ GET CLOSER LEVEL CONTROL WITH THE COPES FLOWMATIC ★ REGULATOR

FEEDS BOILER ACCORDING TO STEAM FLOW-AUTOMATICALLY

THE CONQUERING KILOWATTS

by Lowell Thomas



NOTE TO READERS:

The article reprinted here appears, as Johns-Manville paid advertising, in the January 24th issue of the *Saturday Evening Post*. It is one of a series by well-known writers on the defense achievements of the major industries of the country.

Because of our long and close association with these industries, Johns-Manville knows, at first hand, the job which Industry is doing in arming our country. But we are convinced that too few people realize the magnitude of that job and, like other manufacturers, we believe it is vitally important that this story be told to the widest possible audience.

It is our sincere hope that this series in the *Saturday Evening Post* will be helpful in informing the public of the indispensable job American Industry is doing in this time of our greatest National Emergency.

Johns-Manville

ONE of the absolutely prime requisites for national defense is *power*—power to put industry in high gear—power to do the almost inconceivable task that lies ahead. For power is the parent of every gun, every tank, every plane, every ship. It is truly America's first line of defense.

How *much* power can America produce?

It took a little digging on my part to discover that, right now, our power capacity exceeds that of Italy, Germany and Japan *combined*. Today we have fifty-five million kilowatts. Within another year American capacity will be at least sixty million kilowatts . . . sixty-four million by 1944.

Simple Terms

Those are big figures, but what do they mean, brought down to simple visual terms? Well, one kilowatt is the same as one and one-third horsepower. That means a single kilowatt has the working strength—the actual physical energy—of 14 strong men. On an efficient treadmill they would be able to lift 500 pounds one mile straight up in the air in an hour . . .

Now multiply those 14 husky men (equal to one kilowatt) by the more than 100 billion kilowatt hours that were sold by power companies last year and you would have power equivalent to more than *seven hundred million men*, working forty hours a week, fifty weeks a year!

Just look what that means! Seven hundred million of these mechanical workmen are enough to provide the equivalent of more than twenty workmen for every family in America . . . And you and the munitions factories can *get* those mechanical men to work at the snap of a switch! You have here, it seems to me, a beautiful example in strictly human, flesh-and-blood terms of what American power engineers have been able to do to reduce back-breaking toil—to make life more worth while for all of us—and to speed national defense production in our present emergency.

Power Enough Exists

The facts support our power company executives when they say we will have enough power to meet any immediately foreseeable demand.

"Okay," says the Man in the Street, "we've got enough kilowatts—millions more than Hitler has. But how do they compare to the requirements of defense plants, and can they keep our houses and stores lighted and run our non-defense factories at the same time?"

That was what I asked Colonel H. S. Bennion, Vice-President and Managing Director of the Edison Electric Institute, which is, among innumerable other activities, the central information bureau of the Power Industry.

"Speaking in general," said the Colonel, "there are plenty of kilowatts for every purpose at the present time, despite the heavy defense loads we have taken on.

"You see, the electric industry maintains in normal times a reserve generating capacity averaging about 35% over normal requirements. This is a reservoir of power that can be tapped to meet extraordinary needs.

"And there is still another reserve that can be utilized," Colonel Bennion continued. "The 'peak load' is sustained for only about four hours a day. The other twenty hours we operate at only 45% of total capacity. Merely by re-adjusting working hours in a certain percentage of factories, we could thus add another ten per cent to the juice available without switching in a reserve generator or using any of our reserve fuel."

"Have most of the additions in our power capacity been in Federal plants like T.V.A., Bonneville and Grand Coulee?" I queried.

"No. Those are big plants and they're doing a swell job," the Colonel replied, "but it's our electric companies, operated under efficient American business management, who are responsible for carrying out the major part of our power preparedness program. All the Federal Government power plants together supply only a little more than 7% of the nation's power—municipal plants perhaps another 5%. The great majority of power is generated by privately owned and financed companies. Perhaps I should say publicly owned and financed, because their stockholders are numbered in millions."

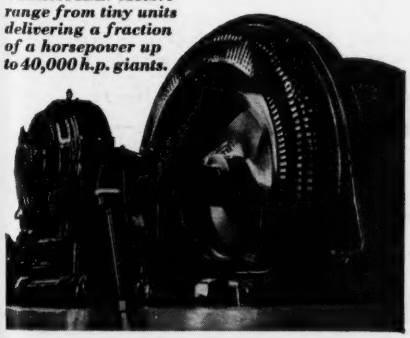
That is the broad, general statistical background of Power in Defense. Adequate power now and expanding capacity for future needs.

Doers—not Talkers

Power men are all a good deal like the quiet, efficient mechanisms they tend and operate.

(Continued on next page)

VERSATILE! ***Motors range from tiny units delivering a fraction of a horsepower up to 40,000 h.p. giants.***



This is the seventh of a series of advertisements sponsored and paid for by Johns-Manville. For more than 80 years this company has been serving America's basic industries.

How indispensable these industries are to the American Way in time of peace is generally recognized. This series is to help inform the public of the indispensable job these industries are doing in this time of great National Emergency.

Johns-Manville is proud of the contributions its products are making in helping the Electric Power Industry, as well as other industries, produce defense material quickly and at the lowest possible cost.

JOHNS-MANVILLE

THE CONQUERING KILOWATTS

(Continued from preceding page)

They function with little sound and no fury. And while they have plenty of imagination in doing their work, they don't allow themselves much in talking about it.

They'll tell you casually about spanning fifty or a hundred miles of wilderness with a 25,000-kilowatt line to a new training camp or an armament plant. But they won't speak of the eighteen-hour days of executives who don't get home to dinner once a week, of engineers whose cots are set up beside their drafting boards, of purchasing and material men who plead and wheedle to get supplies, and of surveyors, right-of-way men, diggers and bulldozers and foresters and linemen who clear the path for the power and erect the high voltage lines along which the kilowatts travel.

Keep 'em Marching!

"Our job is to maintain supply," said H. F. Smiddy, operating head of Electric Bond and Share Services, who was interviewed together with President F. W. Bird of Montana Power Company and Kinsey Robinson, President of Washington Waterpower.

"In other words," said Mr. Bird, "it's our job to keep the kilowatts marching and bring up the reserves as commanded." "And it is noteworthy," said Mr. Smiddy, "that it is the integration of corporate structures that has made possible the interconnection of once-scattered individual operating companies so that power can be spread or concentrated where and when it's required for defense."

"For example," said Kinsey Robinson, "an aluminum plant, which burns up more power than a city the size of Spokane, might be placed, for strategic reasons, in a district where the local power supply was inadequate. But through interconnected lines we could shunt enough power from the surplus of other companies in the system to wipe out the shortage."

"And if there isn't a line to that local plant," added Mr. Bird, "we string one, and the kilowatts get there. I don't know of an important instance in the whole electric network of the country where a power need for a defense plant hasn't been met on time or ahead of it."

Expansion—300%

Whether I talked with holding company heads or operating company executives, I got the same quietly confident story. I found reason for their confidence in the history of the power industry, which, in the characteristic American way, has expanded 300% in twenty years while the population has increased by but 25%.

Throughout the industry I sensed that a spirit of genuine, cheerful and competent co-operation with the government's all-out defense effort was universal.

I learned, from President E. L. Shea of the North American Company and a representative of American Gas and Electric, that electric expansion programs were begun as early as 1939 in anticipation of growing needs for national defense.

Foresightedly, the industry was mobilizing its kilowatts before the action started. What this means for production, and how promptly the kilowatts can be mustered, is illustrated by just one of the examples cited by President H. P. Liversidge of Philadelphia Electric.

"After nearly twenty years of idleness," said Mr. Liversidge, "Cramp's Philadelphia Shipyard prepared to re-open. The Manager phoned me, 'Can we have power in thirty days?' 'In thirty hours,' I told him, 'if you need it.'

"Perhaps it looked like a large gesture, but I was merely stating a fact. We've been able to take the job of powering a 50% increase in defense production in our stride. Bendix, Baldwin Locomotive Company (making heavy tanks), the Navy Yard, scores of factories making every variety of war machines and supplies—they've all had the power when they wanted it, they'll continue to have it for the duration."

—And that situation in the Philadelphia area isn't at all unique . . .

A hundred miles out of St. Louis the Army built Fort Leonard Wood, a camp housing 30,000 soldiers, eventually to hold 80,000. Power lines were run from Union Electric's system to the camp—far outside its territory—and the kilowatts marched in and kept the situation well in hand. Other Union Electric Company kilowatts in ample number were dispatched over other new lines to a T.N.T. plant at Weldon Springs, Missouri, and another munitions factory at Burlington, Iowa.

Down in Louisiana a camp for 40,000 men was laid out. The Army asked the Louisiana Power and Light Company for power in ninety days. Delivering that power meant 600 poles, 400,000 pounds of copper, thousands of insulators, hundreds of transformers, and two complete substations. It meant slashing the right of way through brush, swamps and forests. But the kilowatts marched in—in 75 days!

These operating electric companies in an interconnected system cover the country with a vast network. And from Houston to Boston, Jacksonville to Chicago, and San Diego to Seattle, the power needed in any particular spot has been delivered. Power, you see, is as vital to a nation's military production as is blood in your veins. A country can have men and materials (muscle and bone), but it can't produce planes and tanks without the lifeblood of power. That's why, so often, you read about bombing attacks on power plants in Germany, Occupied France and Italy . . . That's why, when they had to retreat from the Dnieper River, the Russians blew up their beloved Dnieperstroy Dam. Power means production. Production—enough of it in time—means invincible military strength.

EFFICIENCY. ***Research has achieved 300% increase in power output from steam-generated electric plants with no increase in fuel consumption!***

In America all our defense demand, up to now, has been superimposed upon the normal, non-defense requirements of light and power. Utility men say that defense production can be greatly increased and still be handled without cutting the householder's lights or power for luxury items. But they foresee—and business indices already indicate—that defense production is bound to cut into non-defense work, which will lessen the civilian and commercial demand for current. This means that the strain on power resources will be in that degree lessened. "Either way," said a power engineer, "the conquering kilowatts will march on."

For this quiet certainty that power will be adequate, the equipment companies are also responsible. They have accomplished literal miracles in supplying the tools of power production. And along with this job for the utilities, the electric powering of battleships, cruisers, airplane carriers for the Navy and the electrification of merchant ships has been increased and speeded to a degree where only "miracle" is the word.

If anybody wants to call me over-optimistic and over-enthusiastic about America's power plant, that's their good American right of free speech. But I believe that the hardest boiled cynic, or even the dourest defeatist, confronted with the facts as I have found them, would have to concede that the intelligence, energy and daring of private industry are doing a dynamic job of power production.

Built the American Way

Here is an industry that was really ready for national defense. Electric power is now driving 86% of the factory wheels of America. And almost nine-tenths of this vast power mechanism was built and operated by private enterprise, seeking an opportunity for profit, in the matchless American Way. In that search were developed new uses and new markets for power, new comforts and standards of living for Americans, at ever higher efficiency and with ever lower cost. Backed by the savings of millions of small investors, private industry has marshalled the peacetime kilowatt forces into an army more than adequate to America's production needs in a wartime emergency.

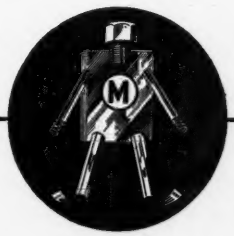
If the outcome of our battle for Democracy depends on power (and many believe it does) the kilowatts are already becoming Conquering Kilowatts in the service of Uncle Sam. And, as far as I can see into the future, they will *continue* their forward march until that final day when the Conquering Kilowatts of Democracy will light the blazing splendor of our Victory Parade.

This is the seventh of a series of advertisements sponsored and paid for by **Johns-Manville** ***and designed to tell the American people how indispensable our basic industries are for National Defense.***

— JOHNS-MANVILLE —

COST-CUTTING IDEAS

for users of PUMPS



New Booklet recounts actual experience of power plant engineers

When you run into trouble with pump rods, shafts, sleeves, or valves, how do you correct it? One good way, that ends frequent repacking of glands and replacement of parts, is to use Monel.

For example: In "Practical Pumping Problems and how they are solved" ship and shore plant engineers give tips on the following:

- **How to get 5 to 50 times longer service from vital parts**
- **How to reduce power, packing, and maintenance costs**
- **General information on pumps by associate editors of "Power"**
- **Successful methods that solved difficult pump problems**
- **How to select materials for handling corrosives**

These improvements all result from use of Monel*, or its heat-treatable forms of "K" Monel* and "S" Monel*. Lastingly resistant to corrosion, these strong, tough alloys eliminate chances of breakdown, reduce repairs and maintenance, and thus help speed the arming of our forces.

FIRST THINGS FIRST

With the nation at war, supplies of Monel, Nickel and Nickel Alloys are needed for our armed forces. Although all efforts must now be aimed towards victory, The International Nickel Company will continue to report developments for the information of metal users who are concerned with the war effort of today and the peace-time progress of the future.

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street **New York, N. Y.**

MONEL *"Monel" and other trade-marks which have an asterisk associated with them are trade-marks of the International Nickel Company, Inc.

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street, New York, N. Y.

Gentlemen:

Please send me without charge.....copies of the booklet checked:

☐ "Practical Pumping Problems and how they are solved."

☐ "List B" of available Bulletins and Instructions.

NAME TITLE

COMPANY

ADDRESS PPE-1-42

BAILEY METER CONTROL *at Oswego*

Complete Boiler Control System Continuously Insures Optimum Conditions

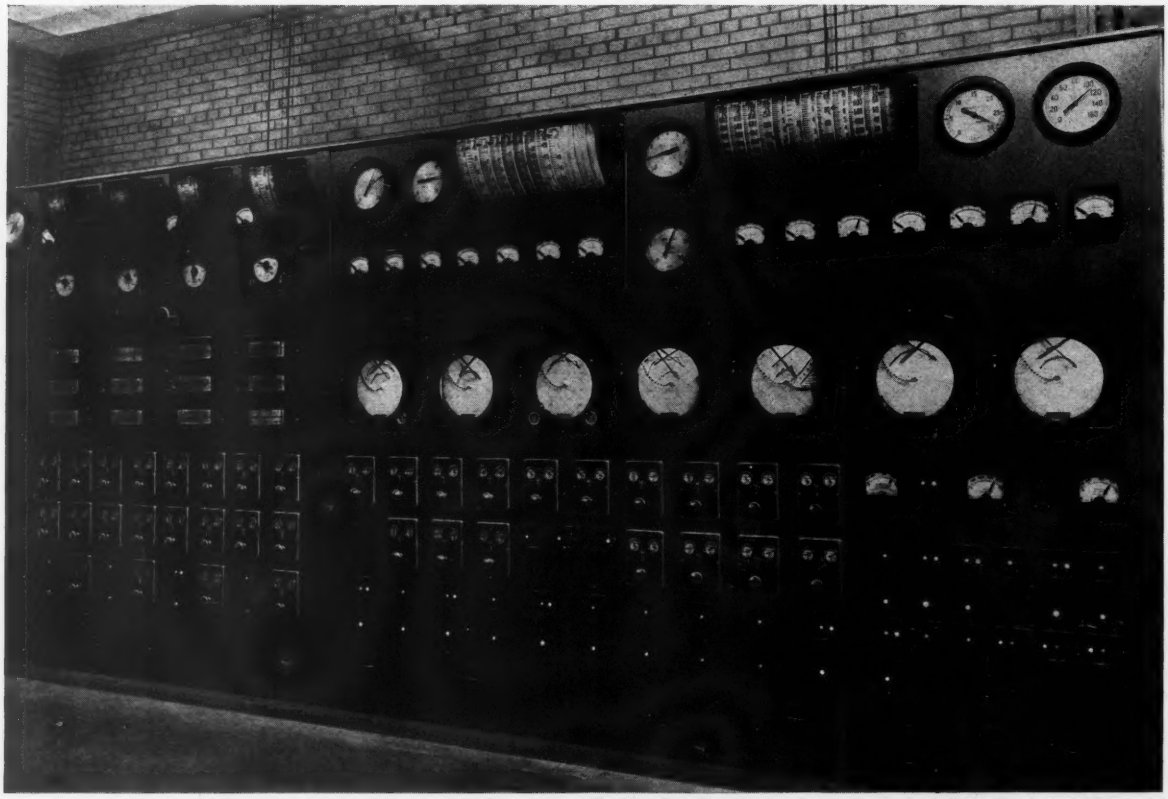
● At the Oswego Station of Central New York Power Corporation Bailey Meter Control is applied to:

Combustion	Heater Drainage
Feed Water	Cooling-Hydrogen
Superheated Steam Temperature	Temperature
	Coal—Air Temperature
Deaerator Level	Feed Water Pumps

Always on the alert, these sensitive control systems carry out the tedious routine of exact operation. They enable plant personnel to continuously maintain the most favorable conditions—conditions which result in reliable service, safe operation, economical use of fuel, conservation of man power, and the ability to obtain full steaming capacity.

Bailey Meter Control for power plant service is described and illustrated in Bulletin No. 102-C. If you do not already have a copy ask for one now. A-80

BAILEY METER COMPANY
1040 IVANHOE RD. · CLEVELAND, OHIO
Bailey Meter Company Limited, Montreal, Canada



Bailey Boiler Control Panel for one of the 900,000-pound per hour capacity boilers at the Oswego Station of Central New York Power Corporation.

BAILEY METER CONTROL

The Complete Combustion Control System

BOILER METERS • MULTI-POINTER GAGES • FLUID METERS • RECORDERS • SUPERHEAT CONTROL • DESUPERHEAT CONTROL • COMBUSTION CONTROL • FEED WATER CONTROL

WHEN THEY SHOUT—

USE THE SARCO BUCKET STEAM TRAP

It's human to blame the boiler room for lack of steam, but the chances are 10 to 1 that the trouble is due to condensate clogging the steam coils or supply lines—or both.

If the avalanche of production has resulted in yells for more steam in your plant, consider what just one Sarco Bucket Trap—the one illustrated on this page—could do at the most troublesome points in your plant.

It's a bear for punishment—it shoots out heavy loads of condensate rapidly, by means of a simple, sturdy valve mechanism that is positive and stands the hardest service. Air by-pass may be added. Pressures up to 900 lbs. Catalog No. 350.

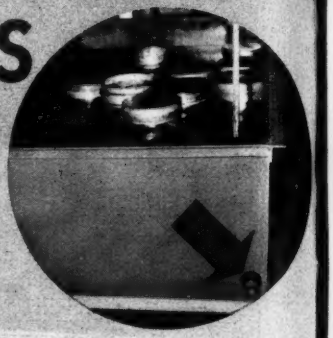
SARCO SAVES STEAM

SARCO CANADA LTD., TORONTO, ONT.

SARCO THERMOTON

THE 2 IN 1 TRAP CONTROL

FOR TANKS

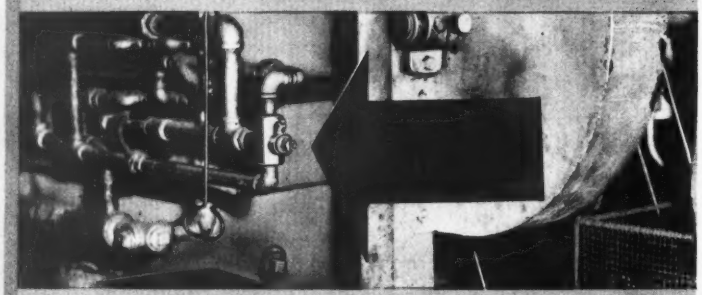


Used Also for
Outdoor Mains,
Storage Tanks
and
Pipe Coils

Perhaps you have never seen a Sarco Thermoton. Although thousands are in use for plating tanks, can washers, chocolate warmers, etc., the device itself is almost invisible when installed.

It is both a steam trap and a temperature control, and obviously quite inexpensive compared with other methods that might be used.

The illustration shows the Thermoton applied to a cleaning tank and to a tank for heating chocolate. A large manufacturer of plating equipment says, "We use three tanks—for alkali at 200°, for sulphuric acid solution at 145° and hot rinse at 200°. The Thermoton is ideal because it gives close enough regulation at low cost and in the acid tank it is unnecessary to use materials that will resist corrosion." Catalog No. 550.



SARCO TR 40

COOLING CONTROL
FOR
STILLS
DEGREASERS
COMPRESSOR AND
ENGINE JACKETS

"A lot for little money."

That's what engineers say after installing the Sarco TR-40 Cooling Control at important points around their plants.

It barely covers the palm of your hand and is installed as easily as a T right in the water line, yet it controls the cooling water on a condenser three stories high in a chemical plant, saved its cost in a week in a textile factory and has been standardized as an essential on degreasers by leading equipment manufacturers.

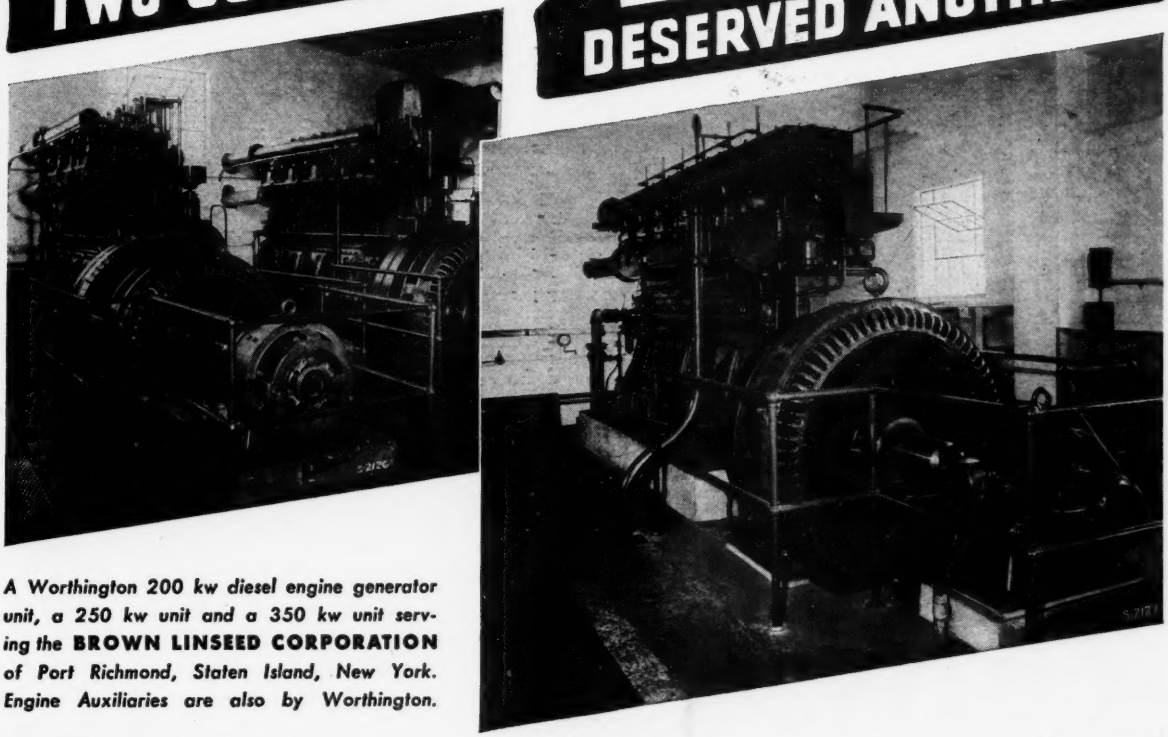
Think what it means to have top efficiency—uniform temperatures with a minimum of water used at similar points in your plant. Then call the Sarco Representative or ask for Catalog No. 700.

SARCO
SAVES STEAM

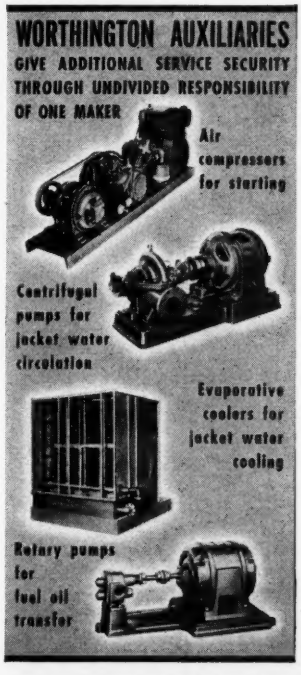
Sarco Company, Inc., 475 Fifth Avenue
New York, N. Y.
Sarco Canada, Ltd., Toronto, Ont.

Represented in Principal Cities

TWO GOOD ENGINES DESERVED ANOTHER



A Worthington 200 kw diesel engine generator unit, a 250 kw unit and a 350 kw unit serving the **BROWN LINSEED CORPORATION** *of Port Richmond, Staten Island, New York. Engine Auxiliaries are also by Worthington.*


WORTHINGTON AUXILIARIES
GIVE ADDITIONAL SERVICE SECURITY THROUGH UNDIVIDED RESPONSIBILITY OF ONE MAKER
Air compressors for starting
Centrifugal pumps for jacket water circulation
Evaporative coolers for jacket water cooling
Rotary pumps for fuel oil transfer

In 1930, after a thorough investigation of all diesel power equipment available, the Brown Linseed Corporation of Staten Island, New York, selected two Worthington diesel engines . . . a 250-kw unit for daytime operation and a 200-kw unit for night and standby service.

Early in 1934, the Corporation's auditors reported that the engines had paid for themselves, in reduced power costs.

In 1938, increased production demanded daytime operation of both engines. Several months of the year the plant ran 24 hours per day, 7 days per week. During these periods the base load would reach 10 percent above the rating of the units with momentary peaks up to approximately 25 percent overload. So, to meet the need for additional power capacity, this excellent record of reliable performance, plus low operating and overall cost, indicated the logical step . . . the addition of another Worthington unit. The two "veterans" are still very much on the job and, with their third partner, a 350-kw unit, provide all of the power for the Brown Linseed Corporation's important activities in supplying the nation's various defense construction programs.

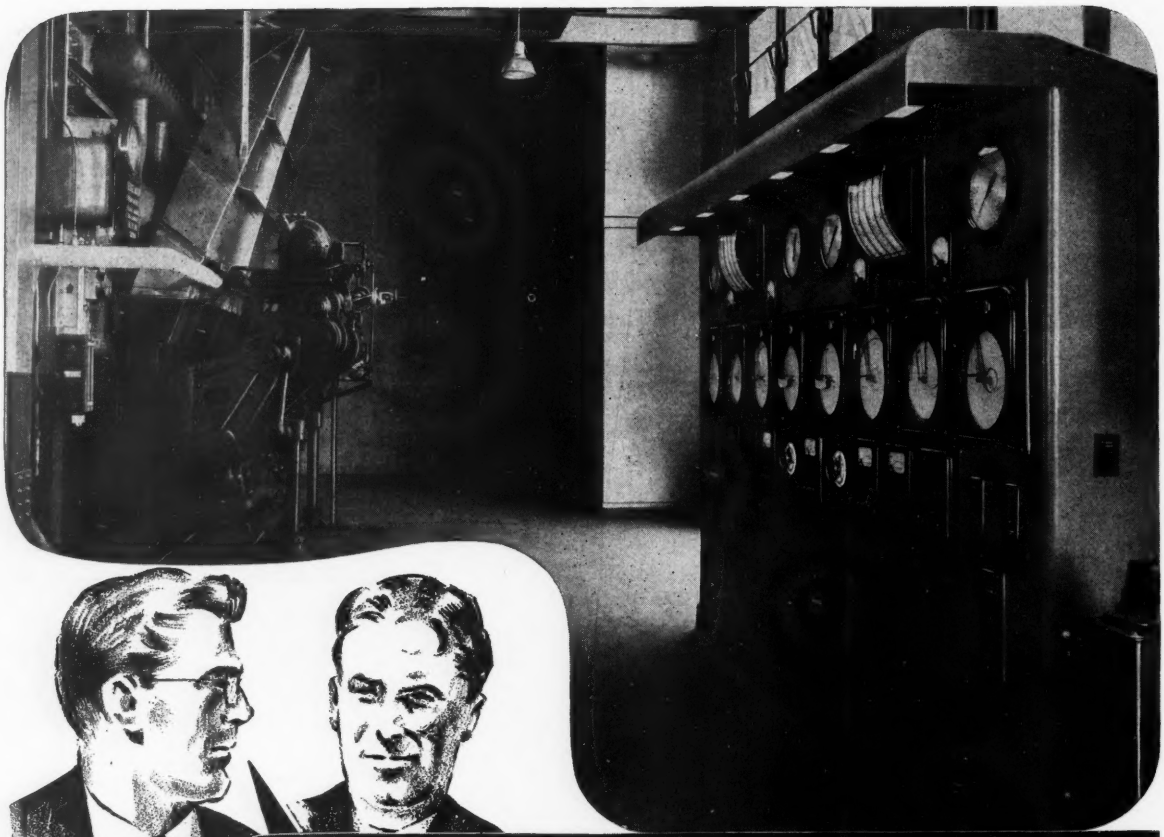
•

A Worthington engine may offer the solution to your present, or future, power problem. Worthington's staff of qualified engineers will be glad to submit a strictly unbiased recommendation for your individual conditions.

WORTHINGTON PUMP AND MACHINERY CORPORATION • HARRISON, NEW JERSEY

DE2-1

WORTHINGTON



"WE SELECTED HAYS CONTROL BECAUSE IT IS EASIER FOR OUR OPERATORS TO UNDERSTAND"

...*So said* THE CHIEF ENGINEER of the above boiler room located in a mid-west municipal light plant. He went on to explain to two engineers* who were investigating several combustion control systems—

"Our men lived with Hays Automatic Combustion Control in our old plant for several years and they liked its simplicity, and its positive operation. Because it was easier to understand than the other systems on the market they took a keener interest in it and produced better results."

"Before selecting boiler control for our new high pressure plant I made trips to several near by cities inspecting the most recent installations of all types of control systems. These trips served to confirm my original opinion of Hays, so we selected Hays for our new plant also."

*The result of this interview was the sale of complete Hays Automatic Combustion Control for 7 boilers in a large automotive product plant.

HAYS *automatic* COMBUSTION CONTROL

is being preferred more and more over other control systems for very definite reasons. In the first place it is completely electric, which simplifies design, installation and operation.

It is the only system that has all instruments and controllers centralized on a single panel and not scattered all over the boiler room or hung on the side of the boiler. Adjustments are direct and not dependent on air pressures, oil pressures, and the complicated valve mechanisms made necessary by most other designs.

You will want to learn more about this thoroughly modern system that is maintaining boiler room efficiency and lowering operating costs in hundreds of plants. Send for 40-page catalog 41-304 today.

The HAYS CORPORATION
SINCE 1903 COMBUSTION INSTRUMENTS AND CONTROL
MICHIGAN CITY, INDIANA, U.S.A.

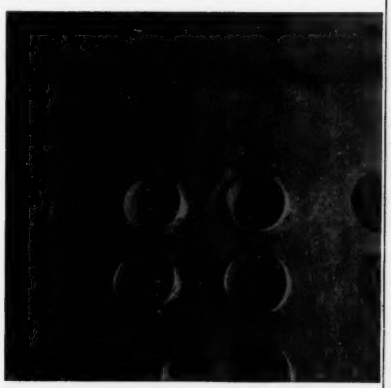
APEXIOR NEWS

A Valuable Ally of Water Preparation under High Working Pressures

The final step, in a series of operations to insure best possible condition of metal in tubes and drums of high-pressure boilers, is the application of APEXIOR coating.

In a large number of boilers now operating in the range from 600# to 1350# W. S. P., APEXIOR is considered a valuable partner of evaporated make-up, deaeration and chemical treatment. Users agree that a definite improvement is effected where this *mechanical* treatment of the metal becomes one of the protective measures.

It provides a comparatively insoluble surfacing for the metal, and guards against adherent deposits due either to unexpected contamination or to excessive baking on of sludge material. As a *refinement* which builds additional security into the boiler unit with a hand brush, and provides tubes which shine up like gun barrels upon brushing for inspection, it also serves, in a less tangible but highly important sense, to improve maintenance morale.



Preparation of all boiler surfaces for APEXIOR has become a standard definition of surface condition with all boiler manufacturers. The procedure required for APEXIORIZING surfaces is now considered the best possible construction handling, whether APEXIOR is to be applied or not. The only added cost is for the APEXIOR and the application, which means a total of 6¢ to 8¢ per sq. ft. in new equipment, including removal of mill scale, material, and application. 1¼¢ per sq. ft. plus painting time once in 2 to 3 years, is the cost of maintaining APEXIOR coated surfaces.

Apexior Prevents Corrosion, Lowers Cleaning Cost on Low-Pressure Boilers

APEXIOR, brush-applied to boiler metal, forms a mechanical bond with the metal and a barrier against water's corrosive action. In new boilers it prevents corrosion; in old boilers, applied after cleaning, it effectively checks corrosion . . . for periods up to 3 years between renewals.

It has the approval and recommendation of all boiler insurance companies in U. S. and Canada.

Since scale does not adhere tightly to an APEXIOR-coated surface, cleaning is much easier and is less frequently required. Under average conditions where scaling water is encountered, cleaning time can be very greatly reduced. The savings in cleaning time and in cost of operation and wear of cleaning tools, the reduction in number and length of outage periods for cleaning, are important and particularly significant during this present emergency.

Old boilers which are practically worn out and would be scheduled for immediate replacement under normal conditions, may often be kept in service indefinitely — by thorough cleaning and establishing APEXIOR as the wearing surface. Many a boiler has had a life extension by that means. Experience has indicated that any APEXIORIZED boiler which is approved for operation today at any specified working pressure, can be passed for the same pressure one year later. APEXIORIZED metal maintains the tensile strength of the date of application without crystallization. That is why some of

the important boiler manufacturers make up all threaded stud or bolt assembly in boiler drums with APEXIOR.

NEW COATING MACHINE CUTS APPLICATION TIME

To reduce the cost of application, we have designed a new tube coating machine with air motor agitation, duplex air and fluid line, and forced feed to the expanding brushes (through a specially-constructed air turbine.)

In addition to saving tube coating time, the coverage has also been improved in quality and uniformity. Have us send you a bulletin containing a complete description.

Write for Apexior Bulletin 1290

THE DAMPNEY COMPANY OF AMERICA

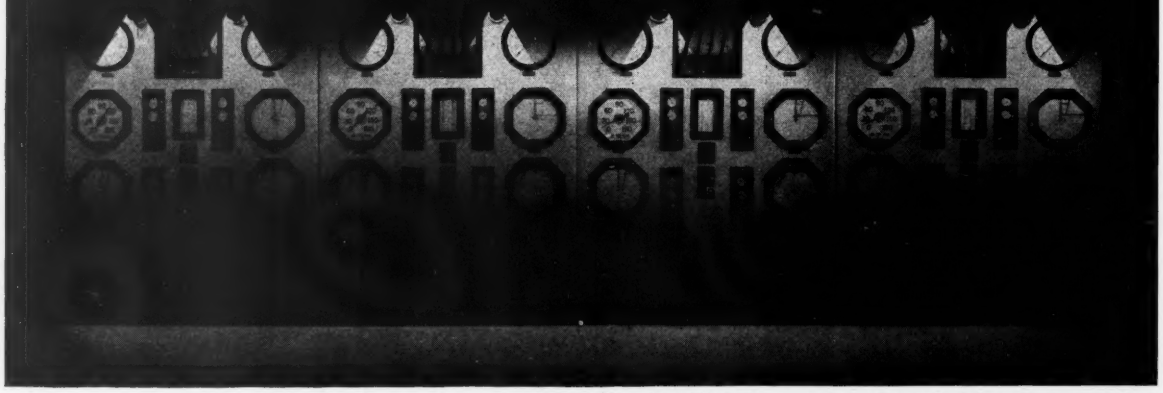
PROTECTIVE COATINGS FOR STATIONARY BOILERS, LOCOMOTIVES AND STEAMSHIPS

HYDE PARK · BOSTON · MASSACHUSETTS

Atlanta Chicago New York Detroit Philadelphia

Engineering Sales Representatives — Pittsburgh, Cincinnati, San Francisco, Los Angeles, Portland, Seattle, Phoenix, Denver, Salt Lake City, New Orleans, Dallas, Houston, Vancouver, B. C., Montreal, P. Q., Havana, Cuba, Manila, P. I., Honolulu, T. H., Marine Dept., 114 Liberty St., New York, N. Y.

READY FOR A Blackout



Republic boiler control panels supplied for a U. S. Army base.

TO provide for complete automatic control of steam generating units, Republic combustion control systems are being installed in many of the new U. S. Army and Navy defense establishments.

The U. S. Government, in planning its new defense bases, must provide for all eventualities, even including the possibility of air attack. Vital to the operation of these highly-mechanized bases is the power plant, where all power services originate . . . power services that must be maintained without interruption if modern defense mechanisms are to function.

To guard against a possible power failure, it is of utmost importance that the steam generating units be equipped with the necessary instruments and controls to assure their efficient, uninterrupted operation even during a blackout.

Republic controls and instruments provide this assurance of efficient, dependable operation.

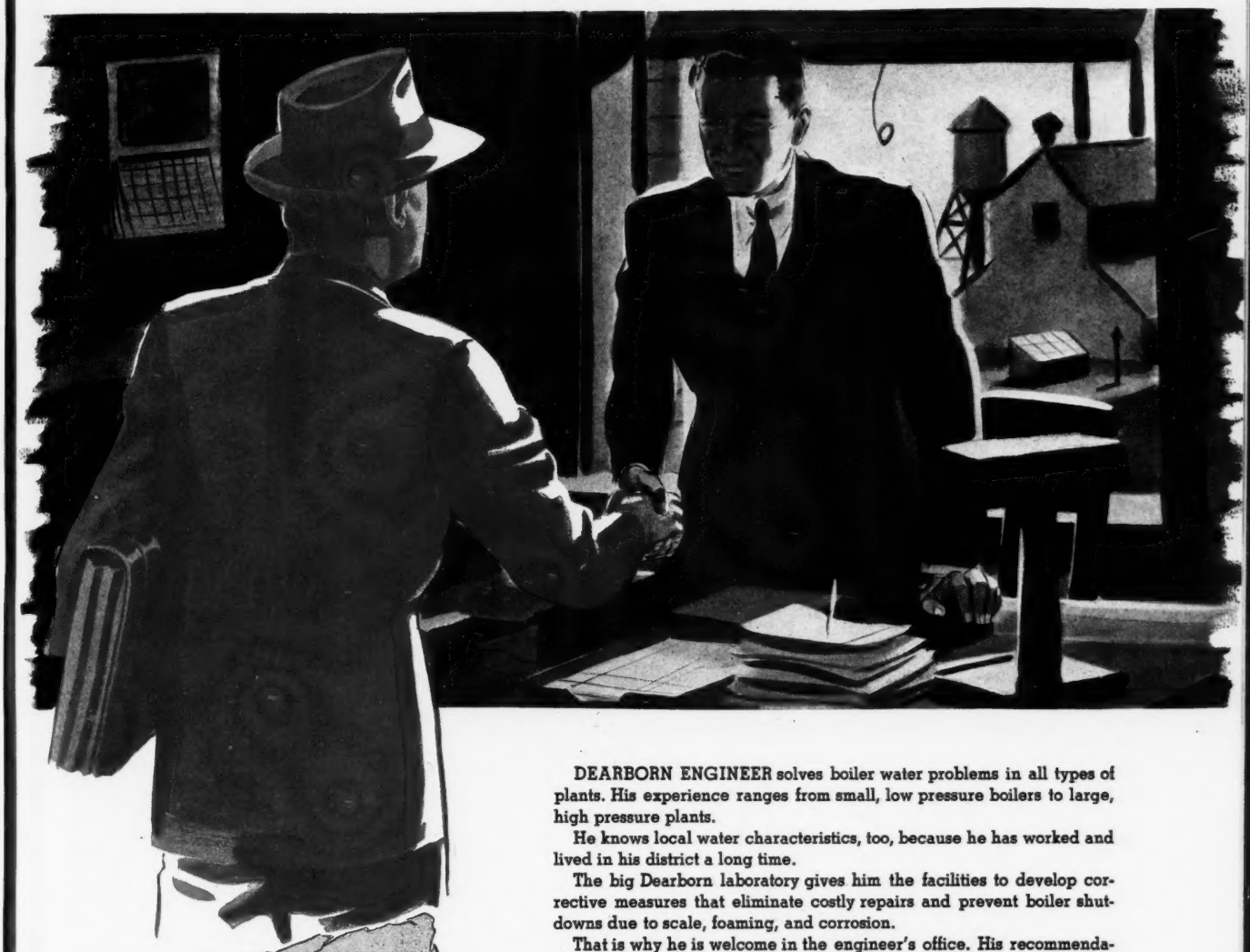
These U. S. Government Plants Have Installed Republic Combustion Controls and Instruments

U. S. Military Academy • West Point, N. Y.
U. S. Army, Ladd Field • Fairbanks, Alaska
U. S. Army, Lowry Field • Denver, Colorado
U. S. Army, Scott Field • Belleville, Ill.
U. S. Army, Northeast Air Base • Chicopee Falls, Mass.
U. S. Army, Elmendorf Field • Anchorage, Alaska
U. S. Army, Wright Field • Dayton, Ohio
U. S. Army, Patterson Field • Fairfield, Ohio
U. S. Army, Camp Blanding • Starke, Florida
U. S. Utah Gen. Supply Depot • Ogden, Utah
U. S. Naval Academy • Annapolis, Md.
U. S. Naval Operating Base • Norfolk, Va.
U. S. Navy Yard • Portsmouth, Va.
U. S. Navy Yard • Pearl Harbor, Hawaii
U. S. Navy Yard • Charleston, S. C.
U. S. Naval Hospital • Newport, R. I.
U. S. Naval Air Station • Quonset Point, R. I.
U. S. Naval Training Station • Great Lakes, Ill.
U. S. Naval Air Station • Argentia, Newfoundland
U. S. Marine Barracks • Quantico, Virginia
U. S. Alabama Ordnance Plant • Childersburg, Ala.
U. S. Kankakee Ordnance Plant • Kankakee, Ill.
U. S. Picatinny Arsenal • Dover, N. J.
U. S. Weldon Spring Ordnance Plant • Weldon Spring, Mo.
U. S. St. Louis Ordnance Plant • St. Louis, Mo.
U. S. Des Moines Ordnance Plant • Des Moines, Iowa
U. S. Utah Ordnance Plant • Salt Lake City, Utah
U. S. Oklahoma Ordnance Plant • Choteau, Okla.

REPUBLIC FLOW METERS CO.
2224 Diversey Parkway, Chicago, Illinois

DEARBORN ENGINEER FINDS THE "LATCH STRING" OUT...

He knows how to solve boiler water problems



Dearborn Engineer does this for you . . .

(1) *Studies* your water and plant operating conditions.
(2) *Sends* samples of your water to main laboratory for analysis.
(3) *Recommends* proper chemical treatment and chemical control methods.
(4) *Supervises* installation of feeding equipment.
(5) *Instructs* your men on water test methods for treatment dosage adjustment and blow-down control.
(6) *Calls* regularly to insure maintenance of recommended conditions.

DEARBORN ENGINEER solves boiler water problems in all types of plants. His experience ranges from small, low pressure boilers to large, high pressure plants.

He knows local water characteristics, too, because he has worked and lived in his district a long time.

The big Dearborn laboratory gives him the facilities to develop corrective measures that eliminate costly repairs and prevent boiler shutdowns due to scale, foaming, and corrosion.

That is why he is welcome in the engineer's office. His recommendations point the way to trouble-free boiler operation. If there's a chemical laboratory in your plant, Dearborn Engineer cooperates with it . . . if not, there's more need than ever for his advice and assistance. And, he's a friend of purchasing agents . . . especially these days . . . because he helps to get prompt shipments of water treatment materials.

He's a good man for *YOU* to know. If you will write us, we'll gladly arrange for him to see you.

DEARBORN CHEMICAL COMPANY
Dept. F, 310 S. Michigan Ave., Chicago, Illinois

Dearborn
WATER TREATMENT AND ENGINEERING SERVICE

The Seal that points to Full Power

"ABSOLUTELY NO RING STICKING, less carbon, better filtration, better overall efficiency . . ." says Mr. Charles G. Hill of Point Pleasant, N.J., on his experience with *Texaco Ursa Oil* in his 12½" x 18" Cooper-Bessemer Diesel.

YOUR DIESEL PISTON RINGS stay free in their grooves . . . continuously assuring compression seal that means full power output and maximum fuel economy . . . when you use *Texaco Algol or Ursa Oils.*

Highly resistant to the formation of gum, sludge and hard carbon, *Texaco Algol and Ursa Oils* keep rings, ring grooves, valves and ports CLEAN. The little carbon that may form is soft and fluffy . . . blows away with the exhaust.

Because of the benefits secured by users everywhere—

More stationary Diesel horsepower in the U. S. is lubricated with Texaco than with any other brand.

The outstanding performance that has made Texaco FIRST in the stationary Diesel field, has made it FIRST also in the fields listed in the panel.

These Texaco users enjoy many benefits that can also be yours. A Texaco Lubrication Engineer will gladly cooperate . . . just phone the nearest of more than 2300 Texaco distribution points in the 48 States, or write:

The Texas Company, 135 East 42nd Street, New York, N. Y.

THEY PREFER TEXACO

★ More locomotives and cars in the U. S. are lubricated with Texaco than with any other brand.

★ More revenue airline miles in the U. S. are flown with Texaco than with any other brand.

★ More buses, more bus lines and more bus-miles are lubricated with Texaco than with any other brand.

★ More stationary Diesel horsepower in the U. S. is lubricated with Texaco than with any other brand.

★ More Diesel horsepower on streamlined trains in the U. S. is lubricated with Texaco than with all other brands combined.

FOR YOUR ENJOYMENT—TWO GREAT RADIO PROGRAMS

FRED ALLEN every Wednesday night. See your local newspaper for time and station.

METROPOLITAN OPERA. Complete broadcasts of great operas every Saturday. See your local newspaper for time and station.

TEXACO

TEXACO Lubricants and Fuels

FOR POWER PLANT EQUIPMENT

RETURN METAL DRUMS PROMPTLY . . . thus helping to make present supply meet industry's needs and releasing metal for National Defense.

POWER PLANT ENGINEERING

JANUARY, 1942
VOLUME 46, No. 1

Cover: The Power Station of the Hawaiian Electric Co., Honolulu, T. H., was the objective of an unsuccessful Japanese bomber attack during the surprise raid on Pearl Harbor last month. The bomb or bombs intended for the plant were reported to have landed in the block just to the left of, and above, the power plant. Acme Photo.

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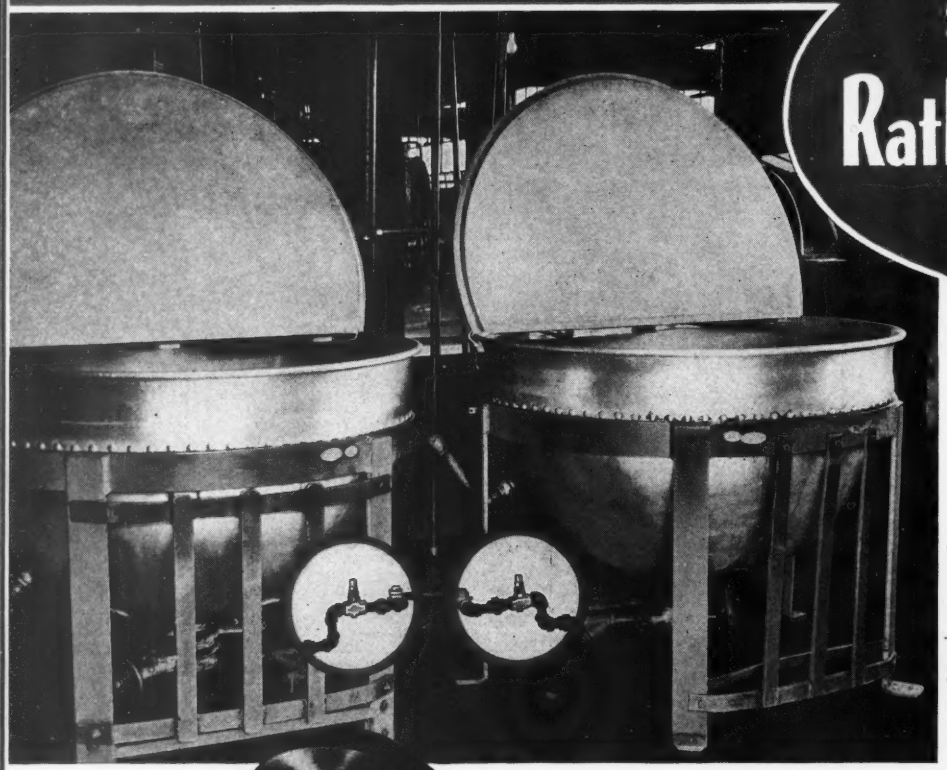
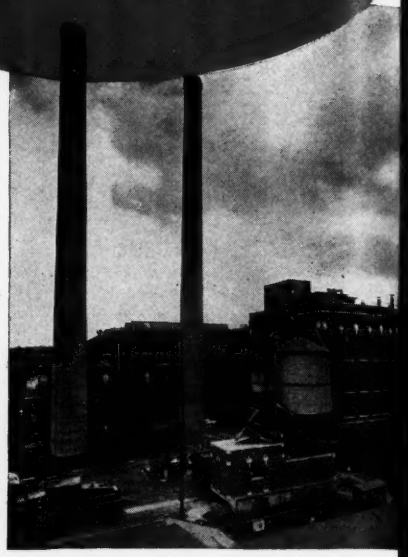
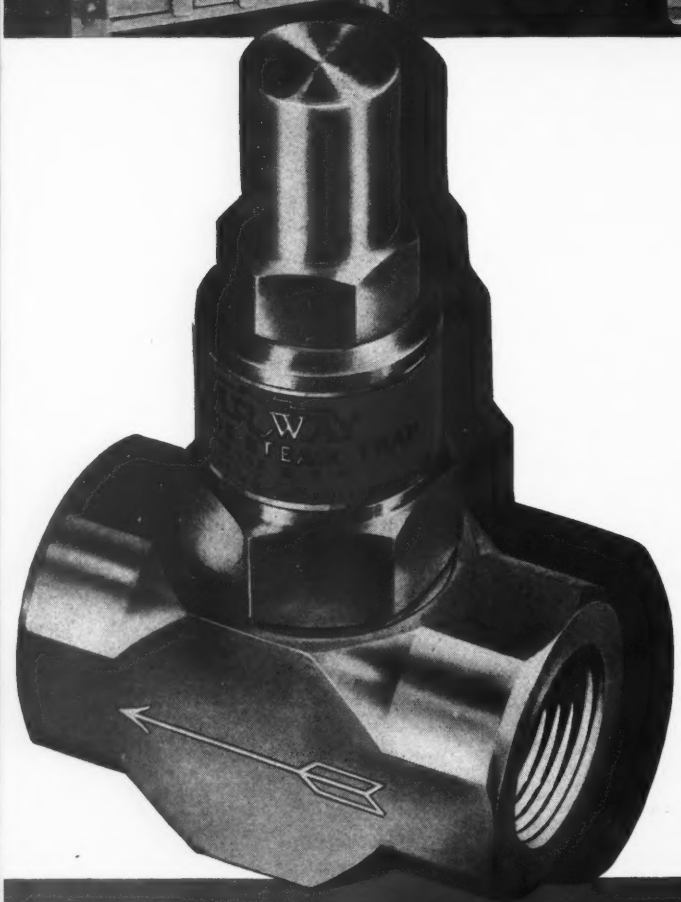
Over Four Hundred Yarway Impulse Traps SERVE Rath Packing Co.







FOR five years, the Rath Packing Company, Waterloo, Iowa, have used Yarway Impulse Steam Traps in their smoke houses, on unit heaters, on coil and pipe drains, on cooking or processing kettles (as shown above), and for various other services throughout their vast plant.

The fact that the number of Yarway Impulse Traps put to work by this company has grown from a few trial units to several hundred during the past 5 years is testimony to the satisfaction that these efficient little traps have given on the job.

You can solve your trapping problem by standardizing on Yarways. They provide *quicker heating; greater sustained heating efficiency; lower installation and maintenance cost; fuel economy; saving in valuable floor space* due to their small size.

Then too, you probably can install new Yarways for *no more than the cost of repairing* the *old traps* in your plant. It's often the case.

See your mill supply dealer—or write for Catalog T-1736.

YARNALL-WARING COMPANY
114 Mermaid Avenue Philadelphia

YARWAY IMPULSE STEAM TRAP

BLACKOUT PLANT SPEEDS PLANE OUTPUT

Says JAMES NELSON

WHEN production of airplane parts and subassemblies got under way in early summer of 1941 in the Douglas Aircraft Co. huge new "blackout" plant at Long Beach, Cal., some 3000 men and women were already at work, with employment rapidly accelerating toward the expected peak of 30,000 skilled workers, who will keep heavy bombers, military transports and attack bombers rolling off the line night and day.

Its assembly lines mechanized and streamlined, the plant incorporates defensive arrangements, construction techniques and production systems never before employed in an airplane factory on this continent. Completely invisible at night from the air, all structures are artificially lighted, air-conditioned, carry duplicated utility services, are of fireproof construction, and colored so as to blend into the landscape.

Utilities and vital materials are safeguarded in subterranean bombproof vaults, with provision made for personal bomb shelters as well. To provide added safety for plant and employes in event of possible air attack, the units are decentralized and housed in separate buildings so spaced as to afford the maximum protection. Eleven units spread over 200 a. include approximately 1,400,000 sq. ft. of covered working space.

To eliminate windows and make blacking-out possible, and at the same time increase the comfort and efficiency of working conditions, the plant was provided with a specially-designed heating, ventilating and cooling system. So huge is the system that its duct work alone required nearly 2,000,000 lb. of sheet metal, while the cooling machinery has a capacity of 4200 t. of refrigeration. This is the largest air conditioning system on the West Coast and was installed at a cost of more than $1,000,000.

While the air conditioning system is unique because of its size, its design and operation as well are expected to blaze new trails in the heating and ventilating field. Instead of installing a central heating and cooling plant which could be damaged or crippled, a system of many individual units was designed.

To speed the manufacture and installation of the necessary equipment and facilitate the start of early production, two air conditioning manufacturers (Westinghouse and York) participated. They co-operated closely with Douglas technicians, the architect-engineers (Taylor & Taylor) and builder (P. J. Walker Co.) in planning the unique system.

The 4000-t. decentralized air conditioning plant was designed to meet specific outside weather conditions, coupled with the high internal load from men at work, machine operations, motors, processes, and lighting, and further taking into consideration the lack of windows and the high sun load on the dull-surfaced camouflaged buildings.

The system will effectively maintain temperature and humidity at efficient and comfortable levels in the manufacturing units at 80 deg. F. dry bulb and 48 per cent relative humidity, in the offices at 78 deg. F. and 50 per cent relative humidity.

In all there are 70 individual refrigerating units, averaging approximately 60 t. each to condition the air of a definite zone, and each having its own condensing unit, compressor, cooling coils, steam heating coils, fan, filters and duct system. All buildings are provided with from 2 to 15 refrigerating and fan units, with the exception of a raw stock and storage structure which required only ventilating. Two or more independent boiler plants are provided to heat each building. The air conditioning comprises Freon direct-expansion units, and the heating system a low-pressure steam system using Kewanee gas-burning boilers.

Overhead installation is a feature of the air conditioning equipment. In the production, receiving and storage buildings, the fan stations are installed on platforms 20 by 25 ft. in size, which in the various buildings range from 22 to 35 ft. above floor level. Air expulsion is through adjustable directional-flow grilles in the ducts directly below these platforms. Air supply outlets are provided in each bay.

Return ducts are installed with drops at the columns along the outside walls to within 6 ft. of the floor, providing proper air circulation at working levels. Each fan station is able to handle in this manner some 36,000 c.f.m. of cooled or heated air.

Servicing of the overhead units as well as lights and traveling cranes is simplified by a system of connecting 3-ft. catwalks, protected by guard rails, to which access is available through hatches in the roof. Service men can move from one platform to another in a building without descending to the floor.

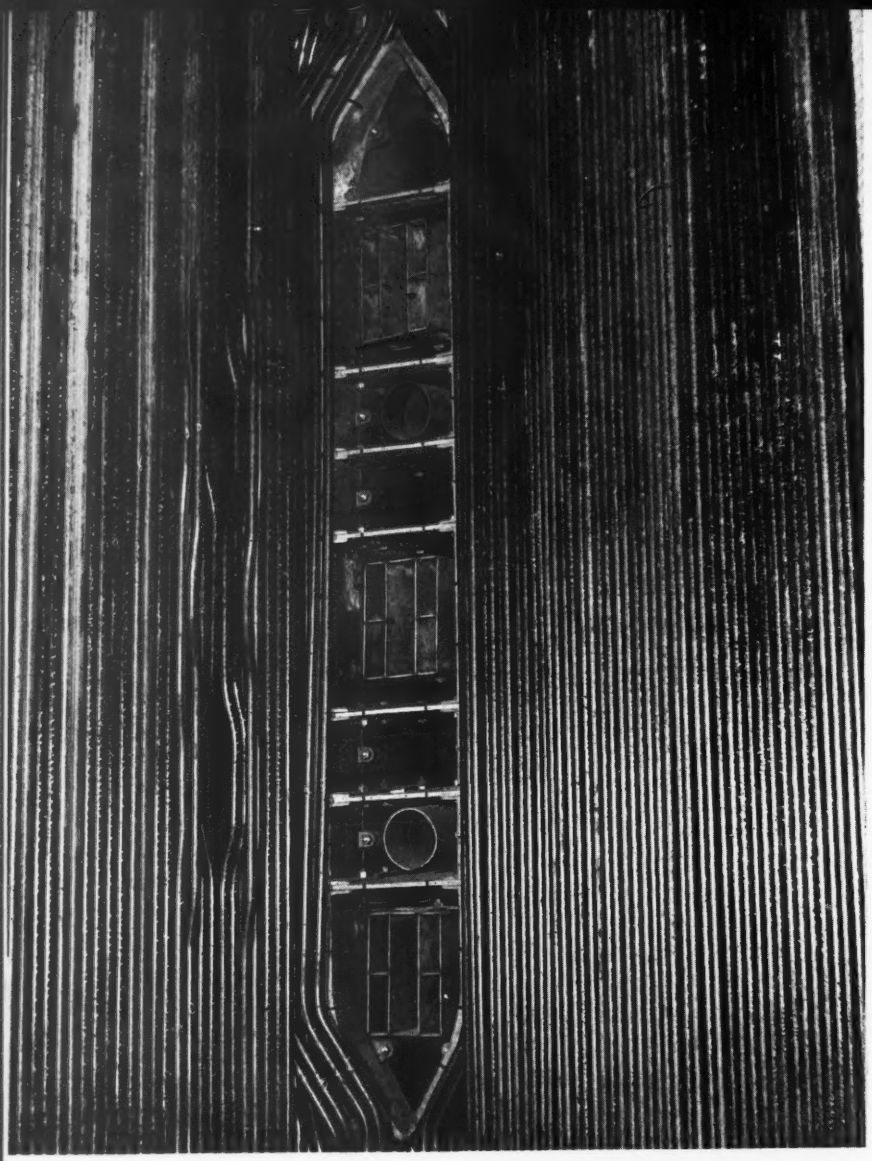
In the administration and other non-manufacturing buildings, conditioning units and heating coils are installed above the ceilings, with air expelled through Venturi-Flo outlets mounted in ceiling. Also of decentralized type is the heating system, with 22 individual steam boiler rooms providing a total of 236,320 equiv. sq. ft. of direct radiation.

Every 24 hr. the supply, exhaust and recirculating fans of the air conditioning system handle more than 3,470,000,000 cu. ft. of air. To drive the ventilating and cooling equipment, approximately 5700-hp. of electric power is utilized.

In its operation the elaborate air conditioning system of the Douglas Long Beach plant has already shown extensive and significant results—enhanced employe morale, fewer industrial accidents, and less non-industrial illness—all bearing directly on the speed and success of the national defense production drive for aerial security.

JAMES NELSON, plant engineer of the new Douglas Long Beach plant, attended the University of Wisconsin, but as a young man headed for the West Coast and over a period of 20 yr. there has gained a wide practical experience as a construction and design engineer in the petroleum, chemical and power machinery industries.

He joined the Douglas organization 3 yr. ago in the plant layout department of the El Segundo unit spending the daytime doing outside supervisory work and nights over a drawing board. When construction began on the Long Beach plant November, 1940 he served as field co-ordinator between the various interested parties. As the original units neared completion he was named plant engineer. He has won praise for handling difficult and complicated tasks well—and his problems are not over for an expansion program has already been launched to double the size and capacity of the already huge plant to help meet the tremendous needs.



Photo, Combustion Engineering Co., Inc.

NOT A PIPE DREAM

IF this looks like a pipe dream, we can assure you it isn't. Forced circulation boilers may be new in this country but the design and construction of this Combustion Engineering Co. unit, now being installed at Somerset Station of the Montaup Electric Co., is based on the experience gained with some 900 installations of forced circulation boilers in Europe. The photograph shown here is a view of a corner of the furnace in the Somerset furnace showing one of the tangential burners. Note the small size of the tubing and remember that this tubing making up the furnace walls is really the boiler itself. The furnace alone contains 11.9 miles of such tubing, the unit as a whole, 22.3 miles! Without question, this is the most unusual and interesting boiler installation being made in America today. And its not peanuts! The tubes may be small, and the overall size of the unit also, but this "fabric" of tubes will turn out 650,000 lb. of steam per hr. at an operating pressure of 1825 lb. per sq. in. and a steam temperature of 960 deg. F. The water is pumped through the boiler by circulating pumps which have a capacity of 3500 g.p.m. each. When two of these are operating they will circulate all the water in the boiler in 1 min. Further details will be found on page 52.

WITH THE EDITORS

◆ **OUR ONLY OBJECTIVE . . .** That which some thought was inevitable, others thought was impossible, and a few thought was unnecessary, has happened. The paralyzing effect of the Japanese surprise attack on Pearl Harbor was momentary, the reaction immediate and declarations of war against a new enemy ringed the world to weld this nation and its new allies into a single chain of fighting units.

"War has been forced on America . . . through no volition of any American," said the Chicago Tribune in a front page editorial presaging its reversal of policy after years of fighting the present Administration's foreign and domestic policies.

We believe that is typical of the present American feeling, that the Star Spangled Banner played at the conclusion of the President's first wartime radio address had a real significance for the first time in a generation and that the first part of Stephen Decatur's famous toast "To My Country, may she ever be right" is entirely adequate.

Nevertheless some feel that there is war and war—one kind that can be waged ruthlessly, one kind with kid gloves. War is no longer something distant and glamorous waged by a band of professional soldiers, according to a strict code, but a war of nations fought to the death with no rules.

In a quip climaxing the anticlimax of three declarations of war by Congress in four days the veteran Senator Carter Glass made this clear. He said, "Some members of the Senate Foreign Relations Committee had wanted to phrase the declaration so as not to hurt anybody's feelings. I told them, Hell, we not only want to hurt their feelings—we want to kill them."

Strong and violent words but sufficiently realistic to fit into the pattern and mode set and touted by the new order totalitarians. But the outcome will be determined far behind the battle lines, largely in the factories of this country. The outline of this struggle is well covered by the declaration of the Supply, Priorities and Allocations Board, the key agency in the production program:

◆ **—IS VICTORY . . .** "From now on every action by this Board and by the related civilian agencies of the Government must be keyed to one goal—complete victory in this war which has been thrust upon us.

"From this moment we are engaged in a victory program. We can talk and act no longer in terms of a defense program. Victory is our one and only objective, and everything else is subordinate to it.

"It is clear that a vastly expanded national effort is imperative. Production schedules for all manner of military items must be stepped up at once. Every activity of our national life and our civilian economy must be immediately adjusted to that change. To attain victory we aim at the greatest production which is physically possible; we call for the greatest national effort that can possibly be made.

"This policy applies all down the line—in the agencies of Government, in industry, in agriculture, in commerce, in labor, in every phase of national life. There is but one standard for activities in all of these fields—the simple question, 'Is this the utmost that can be done to bring victory?' Policies and actions which meet that test must be adopted; those which do not must be rejected.

"A united people will harness the unparalleled might of the United States to one word and one slogan—Victory."

◆ **UNDER FIRE . . .** One of the first objectives of the Japanese attack on Honolulu was the power plant of the Hawaiian Electric Co. shown on the front cover. Fortunately the attempt was unsuccessful but the lesson is clear. The truth of Colonel Hutchinson's warning (p. 51, December, 1941) of the practicability of enemy bombing raids and their probable objectives of American industrial and utility plants was effectively demonstrated a few days after the issue was off the press.

Nor is this probable air bombing the only danger. As a democracy we have been lax on espionage and sabotage activities which may well have a greater effect on plant output than bombings.

◆ **PLANT PROTECTION . . .** Protection of the key utility plants has long since been under the wing of the Federal Power Commission. Protection of industrial plants from the standpoint of sabotage and counter espionage (see p. 50, December, 1940) has been one of the duties of the F. B. I. While the F. B. I. is still active in this, plant protection from a much broader point of view now comes under a new Plant Protection Unit of the Office of Civilian Defense.

A large number of new government agency bulletins dealing with this problem are listed in the first part of the New Engineering Book section of this issue. Familiarity with these phases of war is the direct responsibility of all industrial plant executives.

◆ **WAR PRODUCTION . . .** Original production schedules called for doubling our present war needs output by June. Under war conditions this has been speeded up and by the end of this year necessity will dictate a war output of probably 50 per cent of our total productive capacity.

Here again a good start in organization is available. Army and Navy purchasing practices have already been drastically revised to increase subcontracting. All manufacturers, and most of these are small, not yet engaged in war work of some kind should read the article "If You Can't Do Business" p. 80 of the December, 1941, issue for specific directions as to how to break into this field.

◆ **LABOR SUPPLY . . .** Labor shortages in 1942 were foreseen in a National Industrial Conference Board report issued late in November. Only of recent weeks have industrial executives in general begun to realize that no longer can they depend on help trained by someone else—they must train their own labor. For help contact the nearest branch of O. P. M.—list on p. 83, December, 1941—Training Within Industry Br.

◆ **NEW POWER . . .** In line with the policy laid down earlier on construction, the SPAB recently announced a broad policy covering the building of public and private power projects. The policy directs that every effort be made to aid in the completion of projects now substantially under way, but that aid be withheld from new projects unless they can be shown to be essential to the war effort or to the public health and safety. Details will be found in the News section.

◆ **REMEMBER PEARL HARBOR . . .** Each individual must play some part as dictated by his own conscience, environment, background, training and physical condition. No amount of rationalizing can hide the fact that the brunt of physical sacrifice will be borne by the armed forces—of necessity the young and physically fit.

It is equally obvious that these men depend upon equipment supplied by those who make no sacrifice beyond comforts and luxuries. Some of these people are physically able to be in the fighting forces, some are not. A large portion of the physically able are essential in their present jobs, others would not be missed.

Whether to stay at home or go to war is an individual problem. Patriotism withers during periods of prosperity and blooms during periods of adversity and is largely a question of balancing individual greed and responsibility against the collective responsibility to the nation. The secret of national unity is nicely expressed by an old poem which tells how Poland has existed through centuries of oppression and occupation. It may be freely translated as:

"Poland is one, Poland will always be one, because every Pole considers his country an altar upon which to place his sacrifice and not a trough at which to feed."

MORRELL PLANT BURNS THREE KINDS OF FUEL

Packing house operates in parallel with local utility company on a power interchange agreement and generates only byproduct power in accordance with process steam requirements. To meet the increasing steam load a new 100,000 lb. per hr. boiler was recently installed, normally fired with pulverized Iowa coal but with provision to carry up to half load with either oil or gas. Unusual building condition made it necessary to support the new roof from the boiler columns and hang the outer walls from the roof like a giant umbrella

By

Dan S. Helmick
Helmick, Edeskuty and Lutz
Minneapolis, Minnesota and

Ellwood L. Johnson
Chief Engineer
John Morrell & Co.
Ottumwa, Iowa

INSTALLATION of a second high-pressure boiler at the plant of John Morrell & Co., meat packers at Ottumwa, Ia, is the third step in high-pressure steam production and byproduct power generation. In 1935 a Stirling type boiler with powdered coal firing equipment was installed to produce 90,000 lb. per hr. of steam at 400 lb. ga. pressure and 650 deg. F. total temperature. This installation was made to replace inadequate and obsolete low-pressure boilers.

This unit was operated at 200 lb. pressure until 1938 when it was stepped up to 400 lb. operation to provide steam for a high-pressure turbine. The high-pressure turbo-generator, installed in 1938 had a capacity of 2000-kw. extracted steam at 150 lb. ga. and exhausted at 65 lb. ga.

Power Interchange

A rather unusual arrangement was made with the Iowa Southern Utilities Co., the public service company that had supplied power to the plant previous to 1938.[1] This arrangement provided for operation of the turbine on a byproduct basis only, namely the plant steam demands were supplied through the turbine acting as a reducing valve. Any deficiency in byproduct power is supplied by the I. S. U. and any excess is sold to the I. S. U. which also supplies stand-by service. This obviates the generation of condensing power by the Morrell Co. and makes possible the sale of cheap power to the I. S. U.

Increased Load Requires New Unit

By 1940 the plant steam demand had increased to an extent that if the 400 lb. boiler installed in 1935 was out of service, the other boilers were not sufficient to carry the load. After a study of the cost and economics of installation of another boiler of various capacities it was decided to proceed immediately with the installation of another boiler capable of producing 100,000 lb. per hr. continuously (125,000 lb. for 4 hr.) at 400 lb. ga., 675 deg. F. total temperature.

Design and location of the new unit presented several problems. In the first place the floor space available for the new unit was restricted to the space occupied by two small boilers that were to be removed. It was also decided, in order to reduce costs, to use the shell of the old boiler room to house the new boiler in so far as possible, but it was impossible to

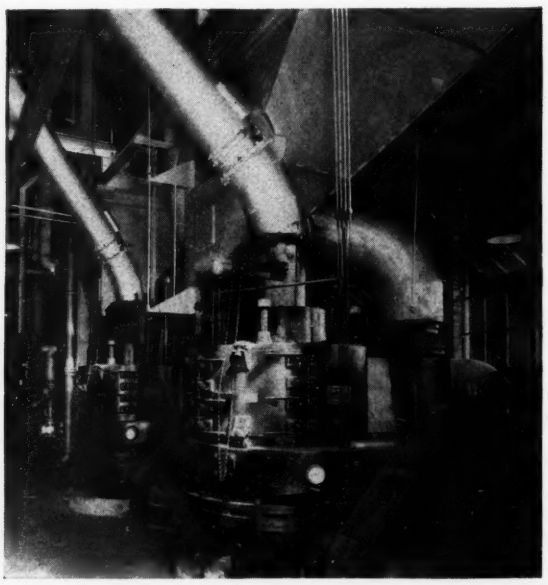


Fig. 1. The two new pulverizers are installed on the main floor and each mill has an individual coal scale on the level above, just over the hopper. The boiler panel is directly in front of, and the boiler feed pumps on the far side of, the second mill. Oil and gas burners are also provided with sufficient capacity to carry the boiler up to half load. The 400 lb., 90,000 lb. per hr. boiler installed in 1935 is at the far end of the boiler aisle

[1]For details of this agreement with typical daily electric load and steam curves see Power Interchange by B. Winger, p. 563, September, 1938.

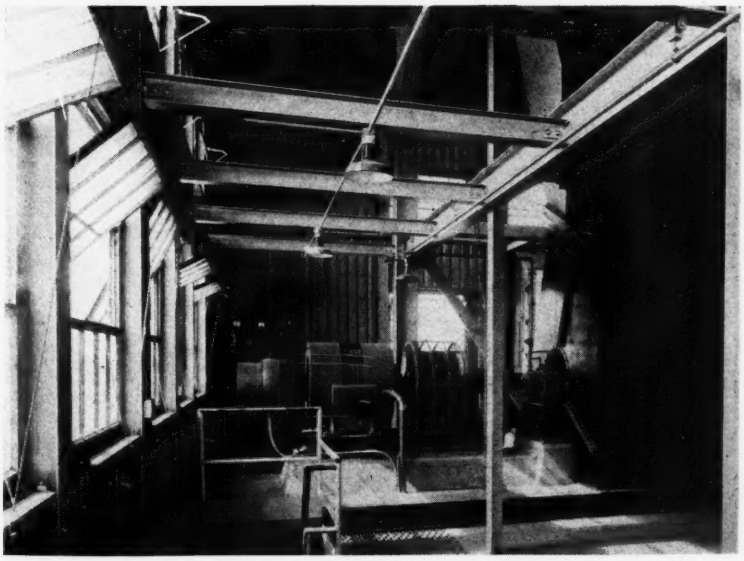


Fig. 2. View of the fan floor showing the motor end of the induced draft fan. Both forced and induced draft fans have dual drive, steam turbines with a magnetic clutch on one end, synchronous motors with variable speed magnetic drive on the other. The magnetic coupling is in the cage just to the right of the motor. A corner of the cyclone dust collector is visible at the upper right hand corner. Note the building construction with the walls suspended from the roof which in turn is carried on the boiler columns

increase the loading on the old walls and footings.

Building Walls Hung from Boiler Columns

This led to an unusual building design which was made as follows: The boiler columns were carried on concrete caissons to rock. The roof supporting steel was framed to and cantilevered over the boiler columns. The sides of the new building above the old building were constructed of vertical steel members and girts suspended from the periphery of the new roof and seated on the top of the old brick building walls. The steel wall frame was covered with protected metal and wind braced to the main boiler columns. The boiler columns were of heavier section than required by the boiler loads alone and were braced to frame a tower to take the wind load.

Return of condensate varies widely from hour to hour and day to day with a high percentage of make-up for long periods of time. The 1935 boiler as well as the older boilers were of the 4-drum Stirling type. They had proved very reliable as to operation with the character of the load and feedwater conditions that existed at the plant. It was therefore decided to purchase a new boiler of the same design.

The only economical source of fuel supply is Iowa coal. This is available by rail or truck, the majority coming in by truck. The 1935 boiler had been equipped with pulverizers and had performed very satisfactorily. Therefore due to the size of the unit and past satisfaction with pulverizers it was decided to use pulverizers again.

A typical analysis of Iowa coal is: 9500 B.t.u. as fired; 15 per cent moisture; 35 per cent volatile; 35 per cent fixed carbon; 15 per cent ash; and 5 per cent sulphur. The ash fusion point ranges from 1800 to 1900 deg. F. The coal contains a large amount of pyrites and is extremely hard to pulverize. In order to prevent slagging, the boiler furnace was entirely water walled and the furnace sized for a 15,000 B.t.u. per cu. ft. heat liberation. The furnace is of the dry bottom basket type with United Conveyor equipment for ash removal. With this coal consistent fineness of pulverization and the elimination of the pyrites are necessary to maintain consistent efficiency and good furnace conditions. With these objectives in mind two unit pulverizers of the ball or grinding type were purchased.

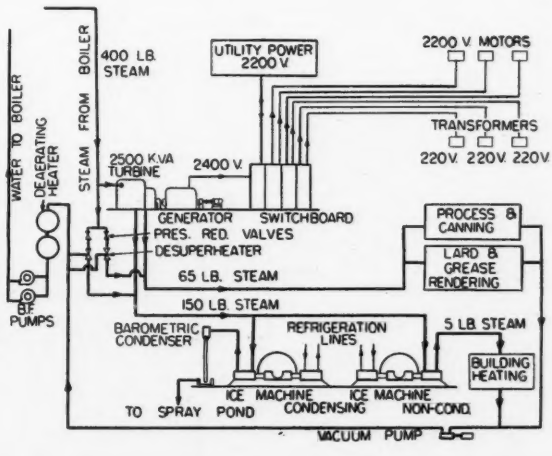


Fig. 3. Diagrammatic sketch showing how the 400 lb. steam is passed through the 2500 kv-a. extraction back-pressure turbine to get 150 lb. steam for the engines, 65 lb. steam for process and 5 lb. heating steam. The turbine operates in parallel with the utility system on a power interchange agreement

Feedwater Supply and Treatment With High Makeup

Feed to the boiler is through a deaerating heater that supplies condensate first and then makeup. The make-up water is purchased from the City of Ottumwa, Iowa. The city water is cold process lime-soda treated, and is after treated in the plant with a zeolite softener. In addition phosphate is pumped direct to the boiler. A continuous blowdown system and flash tank handle the blowdown problem.

The boiler will carry a base load and have a high load factor. This justified the additional money required to obtain consistently high efficiency. Due to the necessity of preheated air for proper operation of the pulverizers this high efficiency was obtained by the installation of an air heater that would reduce the exit gas temperature to 300 deg. F. at a steam output of 75,000 lb. per hr.

It was not felt safe to go below this, due to condensation danger and resulting corrosion of the air heater and breeching. The unit is also equipped with fly ash eliminators of the multicyclone type

LIST OF PRINCIPAL EQUIPMENT IN THE JOHN MORRELL & CO. 1941 POWER PLANT ADDITION

Steam Generator—Babcock & Wilcox Co. Four drum, Stirling type bent tube boiler, Class 42, No. 30, designed to generate 100,000 lb. of steam per hr. at 410 lb. ga., 675 deg. F. t.t. with high volatile Iowa coal. Complete with: Bailey water cooled walls with bare tubes; pendant loop tube superheater; vertical, tubular air heater.

Firing Equipment—Babcock & Wilcox Co. Two, type E, class 221BA pulverizers each equipped with Bailey Meter Co. pulverizer feeder controller. Two B. & W. pulverized coal burners housed in a common casing each equipped with one steam-mechanical oil atomizer and gas burner sized to handle approximately ⅓ the maximum boiler load.

Draft Fans—Clarage Fan Co. One No. 3¼ Type W forced draft fan equipped with dual drive as follows: A Worthington-Moore Type V2R single stage turbine with integral gear reducer connected to a type DL Duplex magnetic clutch manufactured by Cutler-Hammer, Inc.; and on the other end of the fan shaft an Electric Machinery Mfg. Co. 125-hp., 1800 r.p.m., 0.8 p.f., 3-ph., 60-cy., 220 v. synchronous motor with direct connected exciter connected to an Electric Machinery Mfg. Co. Form 20, magnetic drive. The induced draft fan is a No. 13 Type RT equipped with dual drive as follows: A Worthington-Moore Type S2R, 253-hp., 4500 r.p.m., single stage turbine with Worthington-Moore 4500/1500 double helical reduction gear connected to a Cutler-Hammer magnetic clutch type DL No. 28-16; and on the other end an Electric Machinery Mfg. Co., 250-hp., 1200 r.p.m., 0.8 p.f., 3-ph., 60 cy., 220 v. synchronous motor with direct connected exciter connected to an Electric Machinery Mfg. Co. Form 20 magnetic drive.

Soot Blowers—Diamond Power Specialty Corp. revolving elements, Valve-in-head, Model G-9B.

Setting—Boiler setting was provided by Babcock & Wilcox Co. and covered with No. 10 gage steel casing. Burner wall constructed of Detrick sectionally supported tile with 3½ in. of insulation and steel case. Other walls are 3 in. of tile, 4½ in. insulation and steel case.

Coal Handling—Run of mine coal is discharged from trucks and railroad cars to an American Pulverizer Co. coal crusher. The crushed coal is transported on a 20 in. belt conveyor over a 30 in. dia. by 22 in. face Magnetic Engineering Mfg. Co. magnetic pulley and discharged to an 11 in. Redler coal conveyor manufactured by the Stephens-Adamson Mfg. Co. The coal is weighed by two Richardson scales.

Boiler Feed Pumps — Worthington Pump & Mach. Corp. Two, Type 3-UQ-2, four stage, 3600 r.p.m. pumps; capacity each 325 g.p.m. at 1200 ft. head. One direct connected through a Fast coupling to a G.E. 220 v., 150 hp. motor, the other direct connected to an Elliott, Type 3BY steam turbine.

Man Lift—Humphrey Elevator Co.

Ash Equipment—Prat-Daniel Corp., 6-12/4-248 Thermix Multi-cyclone Tubular Dust Collector with four sections equipped with centrifugal dust precipitating tubes between upper and lower tube sheets. An extension of the existing United Conveyor Corp. Nuveyor ash handling system was provided to discharge the ash from the ash pit, rear boiler pass, hoppers beneath air heaters, and dust collectors to an existing ash receiver.

Piping Contractor—Johnson & Larsen Co. Piping contract included extension of high-pressure header to new boiler, medium-pressure steam piping to turbine fan drives, low-pressure steam piping from fan turbine exhausts, feed and blow-off piping, and insulation.

General Contractor—Arthur H. Neumann Co. General contract included concrete caissons under main boiler columns and building columns, extension of coal bunker and supporting steel, and a structural steel frame covered with Robertson Protected Metal.

Valves and Piping—Crane Co.

Non-return Valve — Golden-Anderson Valve Specialty Co.

Blow-off Valves — Consolidated Ashcroft-Hancock, Inc.

Feedwater Regulator—Northern Equipment Co., Copes Flowmatic.

Recorders—Cochrane Corp. boiler flowmeter and temperature recorders.

Combustion Control—Hays Corp. Complete electrically operated combustion control, protective equipment, panel, fan synchronizing equipment, draft gage and CO_2 recorder.

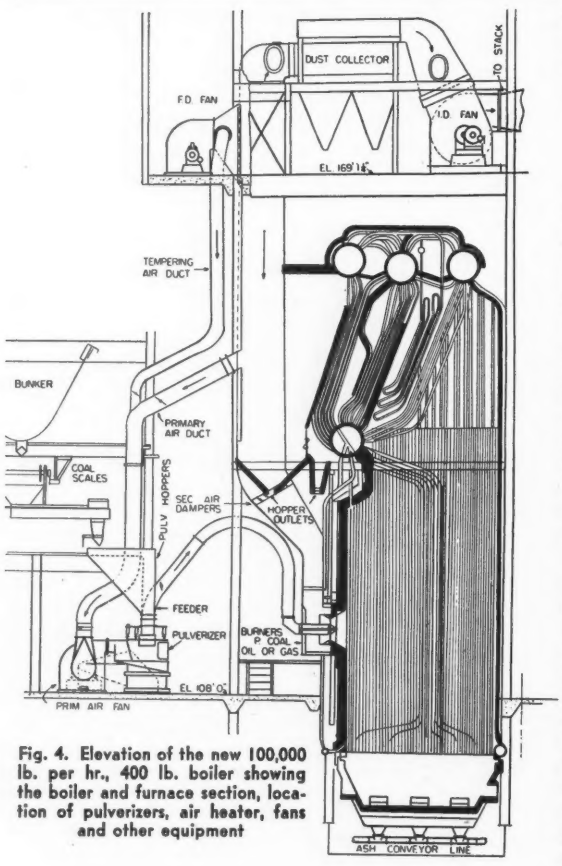


Fig. 4. Elevation of the new 100,000 lb. per hr., 400 lb. boiler showing the boiler and furnace section, location of pulverizers, air heater, fans and other equipment

installed between the air heater and the induced draft fan.

Dual Drive on Both Fans

The boiler will carry the entire plant load a large portion of the year. Under this condition it was imperative that reliable sources of power be available at all times to drive the induced and forced draft fans. This problem was answered by connecting one end of each fan to a synchronous motor through a variable speed coupling of the electric type and connecting the other end of each fan shaft to a geared turbine through a magnetic coupling. This permitted switching from turbine to motor drive and vice versa without even a momentary shutdown of the fans. In addition to obtaining a reliable fan drive this system of dual drive made it possible to shift drives at any time in the interest of a better heat balance.

Operation of the unit and its auxiliaries is handled from a central operation panel. On this panel are locted the boiler flow meter, temperature recorders, draft gages, motor ammeters and control switches for the various motors and control equipment. The combustion control is of the electrically operated type. It maintains the fuel air ratio for the conditions to be met.

Control and Tests

Any control may be readily changed from automatic to hand at the control board. In order to protect boiler and pulverizer operation and to prevent changes of fan drives at improper speeds an elaborate interlock system was installed. Due to the fact that a further detailed article on the control system is to be written[2] no further description of it is attempted at this time.

In addition to the work previously described it was necessary to make the routine changes, extensions and alterations to the

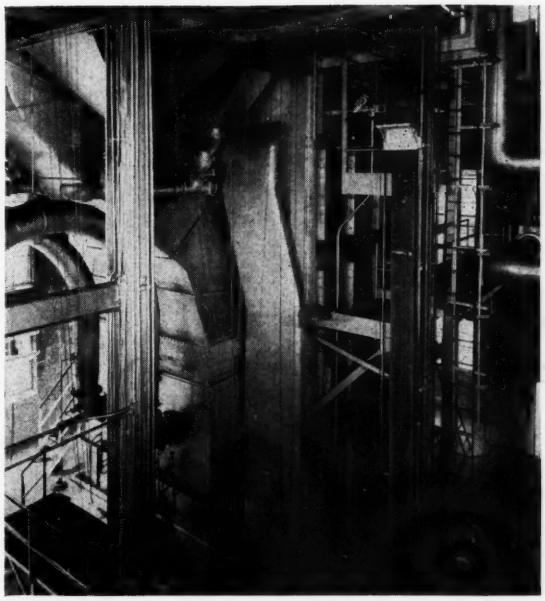


Fig. 5. Front and side view of the new boiler looking downward to show the preheated air ducts and the two burners in a single windbox. Note the manlift near the right side of the picture used in lieu of an elevator to carry the operators from one level to another. The fan floor is over 60 ft. above the operating floor and 76 ft. above the basement floor

coal handling equipment, coal bunker and bunker house.

After the unit had been on the line about a month a test[3] was made to determine what results were being obtained. This test was made in accordance with the A.S.M.E. test code. All coal and water to the boiler was weighed on calibrated scales. Steam, gas and air temperatures were determined with calibrated equipment.

[2]A second article with the details of the combustion control system will appear in a later issue. The system is unusually interesting in that it involves complete interlock and protective features as well as provision for synchronizing the fan speed when changed from one drive to the other.

[3]Acceptance tests run late in October were not completely calculated in time to be included in this article and will be published in a subsequent article.

Coal In The Laboratory

How coal behaves under the influence of heat is revealed by the Coal Research Laboratory of Carnegie Institute of Technology at Pittsburgh

SUPPLEMENTING its previous studies of the burning of coal in fuel beds, the Coal Research Laboratory is conducting an investigation of the combustion of powdered coal. The results show that shortly after a particle is introduced into a hot furnace there is a sudden flare of burning volatile matter followed by a marked cooling of the particle,—evidently due to the exhaustion of oxygen in the surrounding atmosphere. After a few thousandths of a second the particle brightens up again, showing that oxygen is again penetrating to the remaining coke and burning it. Another remarkable result obtained from this study shows that as more coal is supplied in relation to the amount of air passing through the furnace, there is a sudden change from a condition in which individual particles ignite independently, to the formation of a stable flame front, evidently by co-operative action among the particles. This phenomenon is unquestionably of great importance in determining the stability of flames in commercial furnaces.

One of the properties of coal which helps to determine its combustion behavior is its chemical reactivity to air or oxygen. The Laboratory is accumulating data on the reactivity of American coals. It appears that the reactivity depends, to some extent, on the rank of the coal, but all the medium volatile coals fall in the same range.

The Laboratory's study of hydrogenation — the same process which is used in England and Germany for the production of motor fuel from coal — indicates that coals of medium rank, or volatile matter, are apparently best suited for hydrogenation processes. In coals of low rank a very large proportion of the carbon in the coal is converted to gaseous products of relatively little value. On the other hand, the high rank low volatile coals are attacked only with very great difficulty and yield complicated, heavy products which cannot easily be treated further for the production of useful chemical materials. The medium rank coals, however, are more easily attacked than the high rank coals and at the same time are not so completely degraded to gases as the low rank coals.

Acids for Plastics

The Laboratory continues to be the principal source of mellitic acid, an organic acid produced from coal by a controlled oxidation process. This acid, because of its large number of chemically active groups, is of great interest to the chemical industry, especially in connection with the production of artificial plastics. Many industrial organizations have asked for samples of the pure acid produced here.

In almost all of the processes in which coal is used the characteristics of the surface of the coal particles are likely to affect its behavior. The burning of coal on grates depends on how the coal packs; success or failure of a particular coal in carbonization may depend on the bulk density it assumes when charged to the ovens. The operation of almost any power plant or coal treating plant depends on free flow of coal through bins, chutes, feeders, etc. Bulk density, flow properties, and packing properties depend greatly on the surface characteristics of the coal particles. There have been many attempts to influence such surface properties by oil treatment or the addition of chemical reagents of one kind or another. The Coal Research Laboratory is beginning a general study of this problem. Already there are indications of significant results; for example, it has been found that the addition of very small amounts of wetting agents — substances that decrease the surface tension of water — makes water behave like oil in increasing the bulk density of coal. This suggests that the effectiveness of oil itself may be due to traces of such "surface active" materials which are known to be impurities in many oils.

MONTAUP BOILER Nears Completion

When the forced-circulation boiler goes into service in the Somerset, Mass., station of the Montaup Electric Co. it will be the first of its type to be installed in the United States. Circulation will be maintained by pumps that will keep boiler water flowing continuously through the tubes, the distribution being carefully controlled by means of orifice nozzles. Heat will be absorbed principally by radiation from the gases in the totally water cooled slag tap furnace. This unit will supply 650,000 lb. steam per hr. at 1825 psi. 960 deg. F. for a 25,000-kw. topping turbine and will resuperheat the steam used by this turbine for use at 372 lb. pressure and 765 deg. F. by other turbines

AT THE SOMERSET Station of the Montaup Electric Co. the large C-E controlled forced-circulation boiler is now nearing completion and the installation was inspected by a party of engineers (on December 5 following the A.S.M.E. Annual Meeting) who were the guests of J. V. Santry, President of Combustion Engineering Co.

This unit, of 650,000 lb. per hr. maximum continuous capacity at 1825 lb. pressure and 960 deg. F. steam temperature at the superheater outlet, represents the first large-scale commercial application of forced circulation in this country.

Employment of the principle of forced circulation in the boiler proper completes the application of this principle to all heat transfer elements of the steam generating unit. Since the substitution of steel for cast iron in the construction of economizers, this principle has been used. Superheaters for high temperatures have long been designed for considerable drop in pressure through a relative few circuits which in principle is forced circulation. From their inception, air preheaters have depended upon pressure to force air over the heating surfaces. The principle of forced circulation is, therefore, not new except as applied to the water within the steam generating element, and even there operation was dependent upon hydraulic pressure differential due to difference in temperature.

With this steam generator the hydraulic head normally available for natural circulation is augmented by circulating pumps, operating under a differential pressure of about 50 lb. between the downcomer from the upper drum and the headers at the bottom of the furnace. Furthermore, distribution of water to the various circuits is controlled by means of orifices inserted at the entrances to the individual tubes where they connect to the lower header system. The quantity of water handled by the circulating pumps is substantially in excess of the steam production and this insures wetted surfaces at all points where gas contacts the tubes. Circulation is independent of the load.

Heat transfer, except in the second superheater stage, the reheater and the economizer, is all by radiation; and the employment of small diameter tubes, of 1¼-in. diameter, assures a high degree of

Table I. Data on boiler furnace tubing and circulating pumps

STEAM DRUM	
Length	43 ft.
Inside diameter	54 in.
Plate thickness	4 23/32 in.
Weight, with attachments	72 tons
FURNACE (Completely water cooled and continuous slagging bottom)	
Width	32 ft.
Depth	20 ft. 9 in.
Height	48 ft.
Volume	31,000 cu. ft.
Size of tubes	1¼ in. dia.
All tubes bifurcated and connections to drums and headers welded.	
LENGTHS OF TUBING	
Furnace	11.9 mi.
Economizer	2.3 mi.
Superheater	7.1 mi.
Miscellaneous	1 mi.
Total	22.3 mi.
FIELD WELDS (No. exclusive of fittings)	2,640
Water in circulating system (exclusive of economizer)	7,800 gal.
Capacity of circulating pumps	3,500 gpm.
Head on circulating pumps (differential)	50 lb.
Time for complete circulation of water in system (2 pumps operating)	about 1 min.
Power input to circuating pumps in relation to full load plant output	0.30 per cent

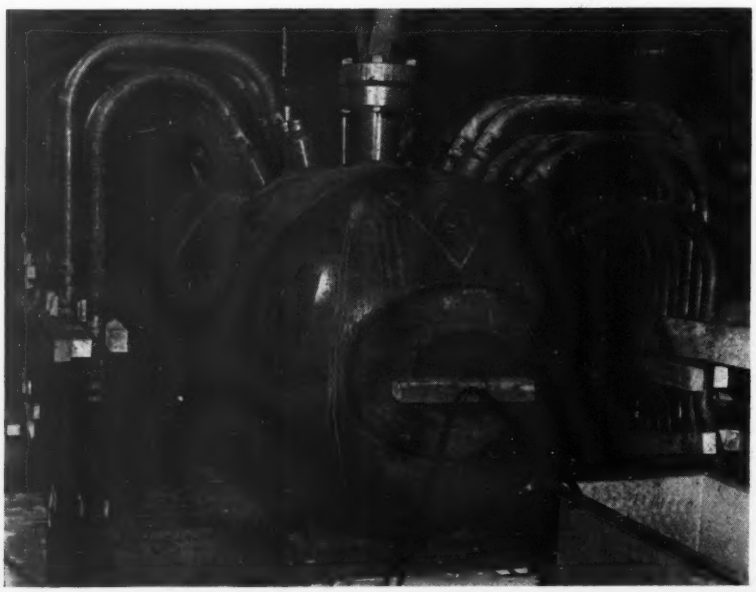


Fig. 1. Tubes are welded to reinforcing rings in the boiler drum as shown in this end view of the dry drum

turbulence under the high velocities employed. This is especially important in avoiding deposits on the tubes.

Forced circulation also permits flexibility in the arrangement of heating surfaces and steam drum to meet space requirements, for the elevation of the drum is not determined by the hydraulic head, as is required to assure circulation in the case of a natural-circulation boiler, particularly where high pressures are involved.

The Montaup unit will be tangentially fired with pulverized coal from the existing storage system in the plant, with provision for oil firing as an alternate fuel. There are 24 burners in all—three pulverized-coal burners and two oil burners in each corner and four auxiliary burners. The furnace is completely water cooled with

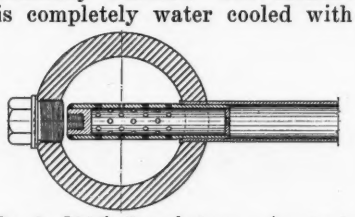


Fig. 2. Distribution of steam and water is controlled by orifice nozzles of this type placed in the inlet to each boiler tube attached to the water inlet header. Nozzles are calibrated for each section of this boiler and the strainer prevents foreign matter reaching the orifice

1¼-in. O.D. bifurcated tubes and the bottom is of the continuous slag-discharge type.

The superheater is of the two-stage Elesco type with temperature control by means of bypass dampers, and a reheater of the gas-swept type, located between the two superheater stages, reheats the steam at 372 lbs. from the 25,000-kw. high-pressure turbine to 765 deg. F. Beyond the reheater is an Elesco fin-tube economizer and beyond that two Ljungstrom air preheaters. Feedwater will enter the economizer at approximately 440 deg. F. A Hagan system of combustion control will be employed. It is significant that this boiler occupies a space originally laid out for one-third the capacity.

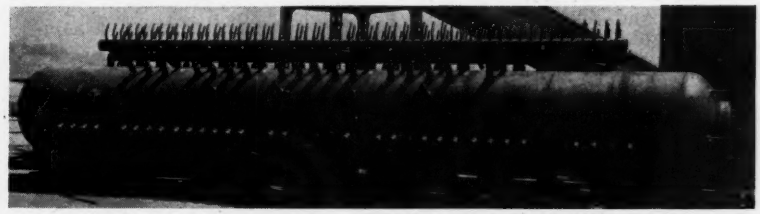


Fig. 3. Main drum on skids at Somerset Station

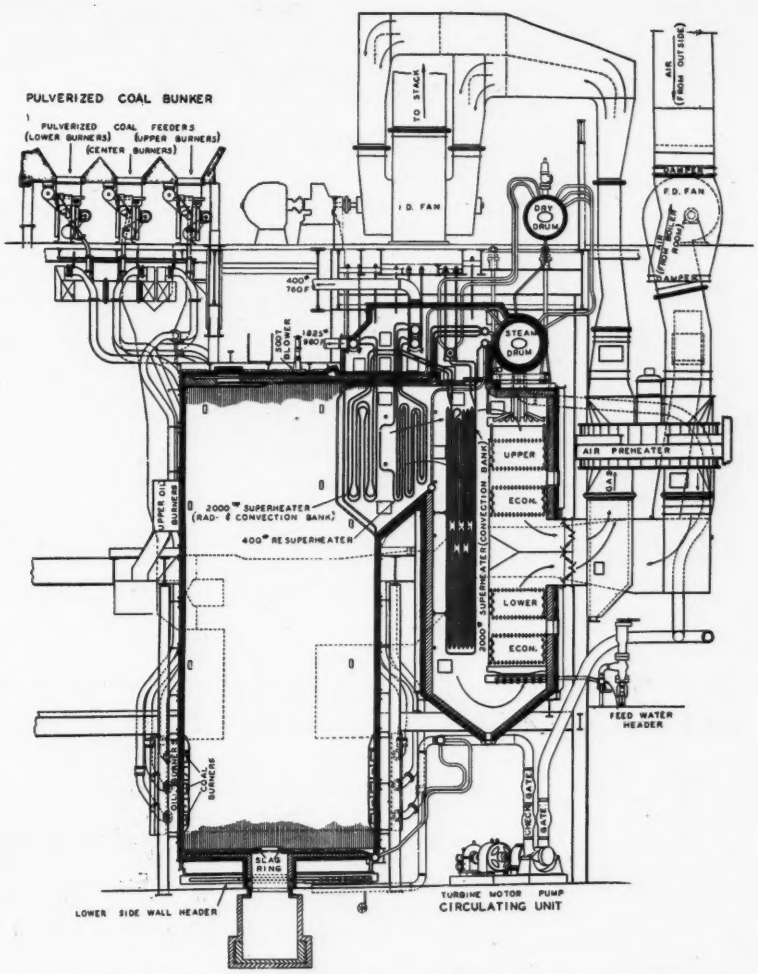


Fig. 4. Section through C-E. controlled forced circulation boiler being installed at the Somerset Station of the Montaup Electric Co.

There are three 8-stage turbine-driven boiler feed pumps of Ingersoll-Rand design, each of 425,000 lb. per hr. capacity. Ordinarily two pumps will be in operation, but if necessary one can be speeded up to supply almost the full load requirements of the boiler. The circulating pumps, of which there are three, operating under 50 lb. differential head are also of Ingersoll-Rand design, each rated at 1,400,000 lbs. of water per hr. Two of these pumps have dual turbine and motor drive and the third is motor-driven.

Table I gives some of the pertinent data:

An interesting comparison of weights between the use of 1¼-in. tubes and what would have been required for the same furnace with 3-in. tubes is afforded by Table II.

Table II. Comparison of weights necessary for 1¼ and 3 in. tubes. Col. 1 is for forced circulation with 1¼ in. bifurcated tubes as actually built. Cols. 2 and 3 are similar data which would have been required for natural circulation. Col. 2 is for 3 in. bifurcated tubes, Col. 3 for 3 in. finned tubes

	Col. 1	Col. 2	Col. 3
Weight of pressure parts (exclusive of superheater and economizer).....	1	1.36	1.17
Weight of furnace tubes only.....	1	2.10	1.56
Water in furnace tubes only.....	1	2.74	1.77
Water in circulation (exclusive of that in economizer)...	1	1.53	1.26
Thermal capacity of water and metal (excl. of superheater and economizer).....	1	1.46	1.23

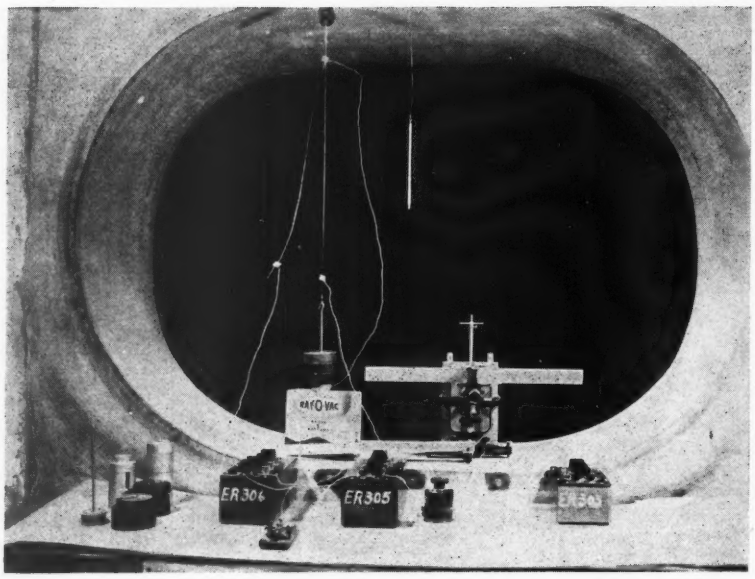


Fig. 1. Experimental test set-up for measuring the changes of resistance under positive and negative increment of stress

STRESS and ELECTRICAL RESISTANCE

This describes a rather interesting investigation of the change of electrical resistance with stress of certain alloy resistance wires. It is the summary of a thesis submitted to the graduate faculty of the University of Oklahoma by the author for the degree of Master of Mechanical Engineering. The results of the investigation show that there is a definite and measurable change of resistance of an alloy wire with direct tensile loads

BY WILLIAM G. JORDAN, JR.

THIS INVESTIGATION was initiated because a knowledge of the changes of electrical resistance of stressed wires would be necessary in the design, construction, calibration and operation of a proposed balance system for the new high-speed wind tunnel at the University of Oklahoma. It is planned to use this method of measuring the forces imposed on a model by the wind stream because of the probability of attaining a greater sensitivity and accuracy than by using the conventional mechanical or hydraulic system.

This device is essentially a temperature compensated wheatstone bridge with the galvanometer remote from the gage. It is essential in a gage of this type that there can be some temperature compensating arrangement, as well as a lack of, or, at any rate, a very slight, constant and known amount of hysteresis or "creep". In this investigation, temperature compensation was obtained by using an unstressed wire of the same material, length and cross-sectional area as a leg of the bridge adjacent to the stressed member. The other two elements of the bridge were identical decade resistance boxes.

Definite Relation Between Stress and Resistance

The results of this investigation show that there is a definite and measurable change of resistance of an alloy wire, when direct tensile loads are applied. This change of resistance results from a reduction in the area and an increase in the length. There is evidently some other contributing factor to this change, since the observed change was greater than the calculated change. It is suggested that this is caused by a re-arrangement of the molecular structure, caused by the stressing, even though the maximum stress was less than two-thirds of the proportional limit.

It is also shown that the amount of change of resistance is not the same when the stress is applied in increasing increments as it is when these same increments are negative. From the experimental evidence, it may be concluded that the magnitude of this deviation varies directly as the specific resistance, i.e., the higher the specific resistance, the greater the amount of this hysteresis. An exception to this was

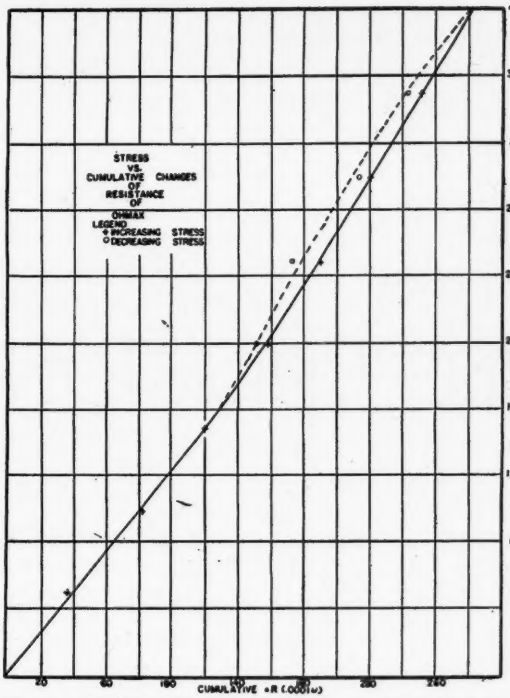


Fig. 2. Cumulative change of resistance vs. stress, showing lack of hysteresis at stresses below 16,000 lb. per sq. in.

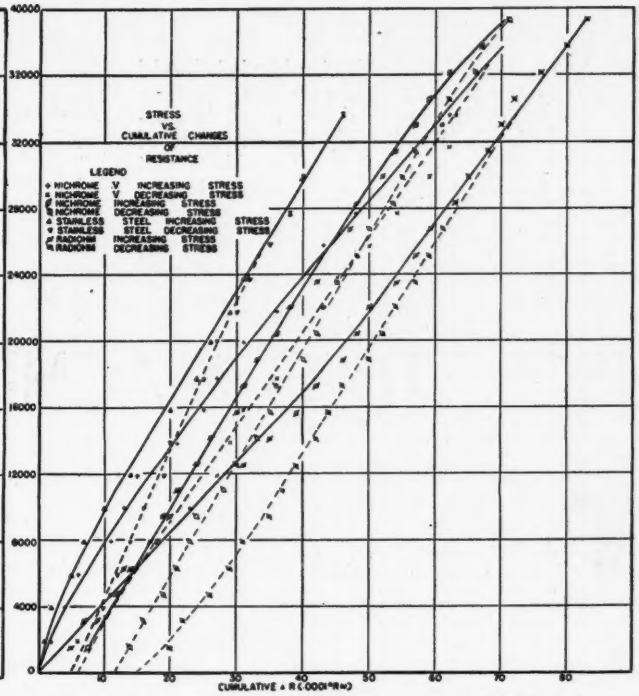


Fig. 3. Cumulative change of resistance vs. stress for different alloys and for stresses ranging up to 40,000 lb. per sq. in.

noted in one instance where the temperature coefficient of resistance of the specimen was negative, rather than positive, as were all the others tested.

This investigation demonstrates the feasibility of the utilization of a modification of this method to measure forces, pressures, stresses, etc., with a relatively high degree of accuracy and sensitivity. The degree of accuracy and sensitivity would undoubtedly be heightened by using an alternating current bridge and amplifier, rather than the direct current arrangement used in this work.

Probably the outstanding limitation on the accuracy and sensitivity of this work was the suspension type galvanometer used in making the electrical measurements. Had the "total deflection" method been used in reading the galvanometer, rather than the "null deflection" method, there is the possibility that the sensitivity would have been somewhat greater. It is to be recommended in this connection, however, as mentioned above, that an alternating current bridge and amplifier be used to attain a maximum of sensitivity.

Insofar as accuracy is concerned, as well as ability to duplicate test results, there is the possibility that some rather interesting results might be obtained if the wire were normalized after being placed in position. This would relieve unequal stress concentration, introduced at the time of manufacture, and would also eliminate the effects of any microscopic wire dent or fractures.

Another phase of this investigation which would prove of considerable value would be one wherein the loading of the wire was of a vibrating nature, these vibrations necessarily being of different frequencies and magnitudes. A knowledge of these characteristics would undoubtedly be necessary in any arrangement of this device which might be used to measure pulsating forces.

Chart number one shows the cumulative change of resistance plotted against the total stress applied, while chart number two depicts the same thing, but displays a lack of hysteresis at stresses below 16,000 lb. per sq. in. It is this material which was spoken of above as having the negative temperature coefficient of resistance. This one difference is the only thing distinguishing this specimen from one of the others.

Thanks are due both to L. H. Cherry and to E. E. Ambrosius of the Mechanical Engineering Department of the University of Oklahoma, for the direction, aid and assistance in this work and to Joseph Tompkin, student at the University, for the photographs.

Payroll Defense Savings

To ASSIST in defraying war costs on an equitable and sound basis an increasing number of business concerns are adopting the Voluntary Payroll Allotment plan for Defense Savings which can be used by any company with three or more employees. Details of the plan are available, without obligation, from the Treasury Dept., Section A, 709 Twelfth St., N.W., Washington, D. C.

The plan provides money now for vital military equipment and gives every American wage earner the opportunity for financial participation in National Defense.

By storing up wages, it will reduce the current demand for consumer goods while they are scarce, retard inflation and reduce taxes.

The percentage of defense financing that must be placed with banks is also reduced, thus putting our emergency financing on a sounder basis, building a reserve buying power for the post-war purchase of civilian goods to keep our factories running after the war and helping reduce the ranks of the needy during that inevitable period of post-war readjustment.

Machines that initiate vibration troubles in industrial plants are now being installed on rubber mountings of designs using rubber in shear as well as compression. To select and apply different types of insulators for various services are problems that require an understanding of fundamental principles

ISOLATING MACHINE VIBRATION

WITH THE DEVELOPMENT of a successful method of bonding rubber to metal by a vulcanizing process, the way was opened, a few years ago, for the design of a type of vibration insulator which subjects the rubber to shearing stresses while previously only the compression quality of rubber was applicable for this purpose. Experience with these newer designs has demonstrated that rubber in shear has greater properties of absorbing vibration and eliminating noise than when subjected to compression due to the greater deflections made possible by designs using shear.

Due to the fact that vibratory forces are so destructive to machinery, supporting foundations, rigidly connected equipment, floors and walls of buildings, to say nothing of the undesirable effects upon people who are compelled to work where noise and vibration subject them to nervous and physical strain, provisions should be made to prevent, as far as possible, operating machinery from setting up vibratory forces. Where this is impractical, the offending unit should be isolated by the use of mountings specially designed to absorb the vibration and prevent it from being transmitted to adjacent structure or machines. As a rule it is not difficult to locate the equipment that is initiating vibratory troubles, but the selection of mountings that will isolate the vibrations is frequently a puzzling problem.

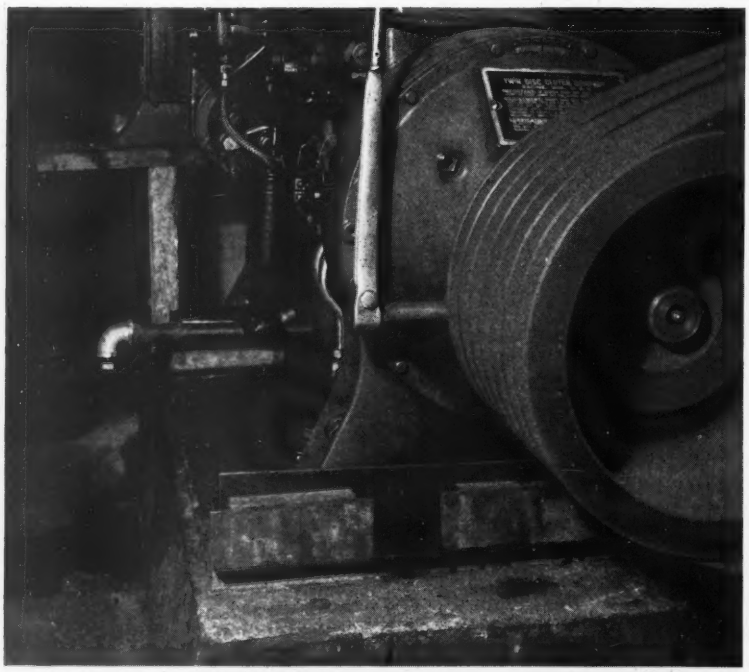


Fig. 1. Diesel engine mounted on Vibro-Insulators shown at lower left hand corner

Uniformity of load distribution is an essential condition for successful use of mountings, otherwise some mountings will be carrying more than their share of load with the probability of premature failure, the effectiveness of the whole installation is decreased by having some mountings underloaded, and the machine is likely to be out of its proper horizontal position.

In order to secure stability of tall, narrow, top-heavy machines, the mountings should be placed as far apart as possible. In some cases stability is increased by placing the mounting at right angles to the direction of the rocking motion.

Horizontal motion when it contributes to objectionable vibration may be resisted by turning the mountings and thus alleviate the condition. Sometimes the insulating device is placed against the machine without being attached to it in such a way as to brace the machine and resist horizontal motion without carrying any weight.

In an attempt to standardize mountings and provide industry with designs that will meet all common problems, B. F. Goodrich Co. has developed 12 types of mountings called Vibro-Insulators most of which employ shear in their functioning, although others use compression stresses. In making the selection of the proper type of Vibro-Insulator, first find

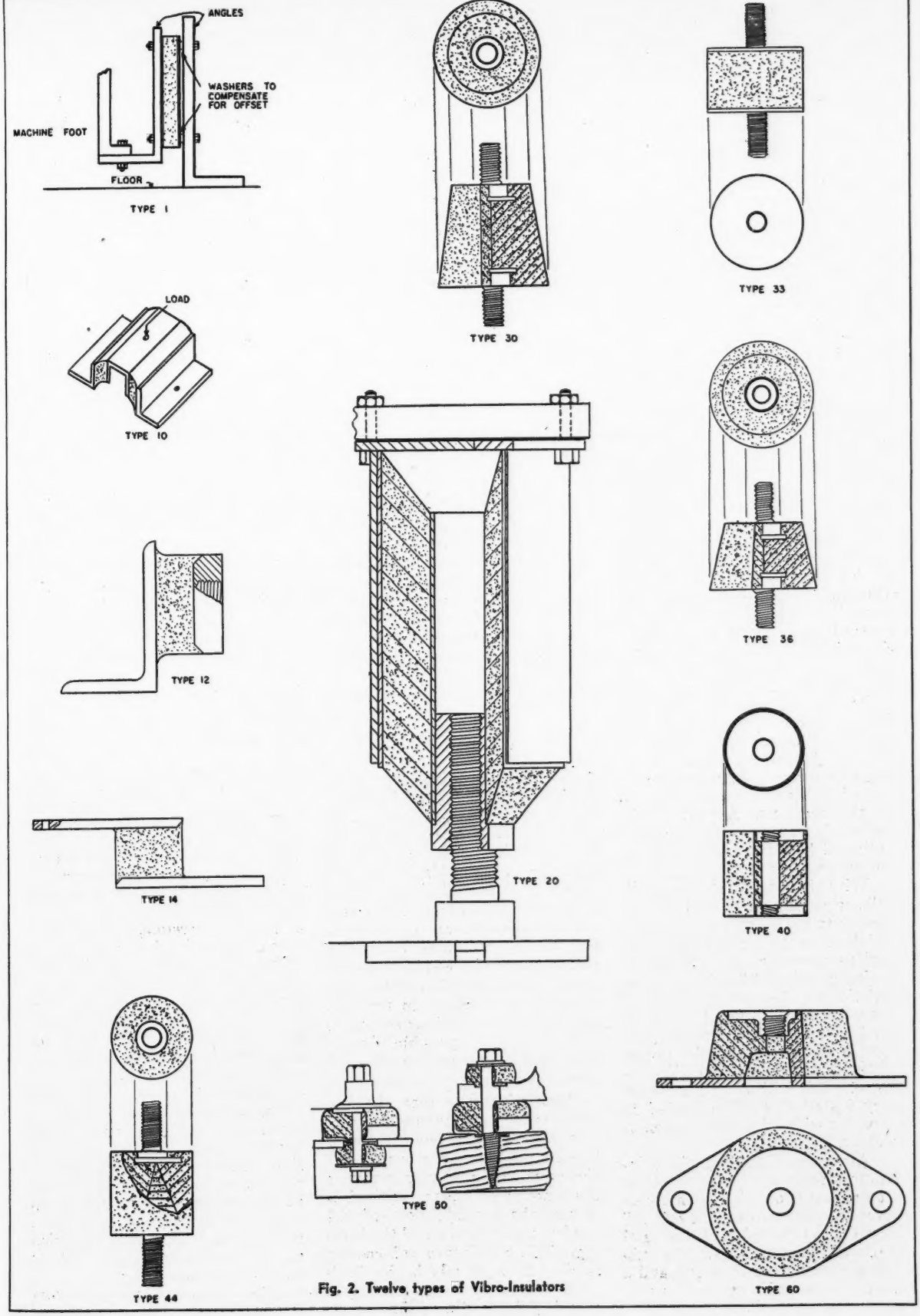


Fig. 2. Twelve types of Vibro-Insulators

Typical services to which vibration insulators are applicable (left) and characteristics of types available (right)

APPLICATIONS

Service	Type Vibro-Insulator
Electric Motors, large and small	10, 30, 40, 60
Air Compressors	12, 60
Punch Presses	1, 12
Internal Combustion Engines, gasoline and Diesel, automotive, marine, stationary	1, 50, 60
Ventilating Fans and Blowers	10, 12
Electric Switchboards	10, 12
Weighing Scales, delicate balances	40
Compressors for Electric Refrigerators	36, 40
Radiators for cooling liquids	10
Heavy Mills	20
Vibrating Screens	1
Motor-Generators	10, 12
High Speed Grinders and Buffers	10, 12
Slow Speed Roll Grinding Machines	12, 14
Wire Drawing Machines	10, 12, 14
Business Tabulating Machines and Tabulators	10
Airplane Instrument Panels	40

CHARACTERISTICS

Type	Deflection at Max. Load (Inches)	Max. Load (pounds)	Durometer Hardness	Min. Disturbing Frequency (per min.)
1	.17	400 each	40	1000
10	1/16	40 per in.	45	1000
12	1/8	75 per in.	40	600
14	1	80 per in.	40	470
20	1	2500 each	35	450
		3000 each	40	450
		3500 each	50	450
30 (Compression Type)	1/16	110	40	1100
33 (Compression Type)	3/32	150	40	1200
36		25	35	940
		35	50	1200
40	.14	10	40	1200
44	3/32	10	40	1200
50			50-60	1200
60 (Compression)	1/16	240	50	1000

the lowest disturbing frequency of the machine. This is usually the revolutions per minute or the number of impacts per minute of the offending machine. In a case where the machine produces disturbing vibrations in more than one frequency the selection of the insulator design should be based on lowest disturbing frequency. The reason for this is that the mounting which is proper for the lowest frequency will be still more effective for insulating higher frequencies.

Next find the correct loaded weight of the machine; then determine the distribution of the weight. This latter information may be difficult to obtain in the plant and it may be necessary to make inquiry of the manufacturer of the machine. As previously stated, however, uniform distribution of load is an extremely essential working condition.

With all this information available, selection can be made by referring to the accompanying table which gives the types suitable for various classes of equipment and in the second part lists the characteristics of the specific types of Vibro-Insulators. The type to be used is that with a frequency as low as or lower than the lowest disturbing frequency of the machine. This will make a satisfactory installation when loaded to capacity with even distribution of weight.

After once installed, these insulators require no care or attention except protection from excessive oil, temperatures over 150 deg. F., and corrosion of the metal parts of the mountings. The rubber is not affected by water and a shield is usually sufficient to protect them from oil.

Effective Closed Heaters for High Cycle Efficiency

For maximum effectiveness closed heaters should subcool the condensate below saturation temperature, by water entering the heater, and, with superheated steam should heat the outgoing feedwater up to or above the saturation temperature. Designs to accomplish this are shown and experimental heating and cooling curves discussed

By R. A. Bowman
Mgr., Condenser Engineering
Westinghouse Elec. & Mfg. Co.

IN THE regenerative steam cycle, the hotter the feedwater is heated in each heater for a given extraction pressure, the higher will be the efficiency of the cycle. In a straight condensing heater, the water can be heated only to within a few degrees of the saturated steam temperature. However, at the higher pressure extraction points the steam contains an appreciable amount of superheat and by heating the water in the final pass by the sensible heat contained in the steam, it is possible to equal or exceed the saturation temperature.

It is also true that the less steam used at any extraction point to accomplish a given amount of heating the higher the overall efficiency will be. One way to reduce the amount of steam required is to use the sensible heat of the condensate to do part of the heating. This requires a sub-cooling section through which the feedwater passes immediately upon entering the feedwater heater.

In a feedwater heater incorporating both desuperheating and sub-cooling sections, the variation in tube wall temperature is high since some of the tubes are in contact with cooled condensate while others are surrounded by superheated steam. In order to reduce as much as possible, the temperature stresses in the tubes caused by this temperature variation, the most desirable design is one utilizing "U" tubes.

There is also a definite transition point between two types of heat transfer, one where the tube surface is dry and the other where condensate is formed. This point varies with the amount of load the turbine is carrying and consequently in the Westinghouse design, instead of having a definite portion of the tube bundle set off as desuperheating section, a longitudinal baffle is used to form a two-pass shell so that the location of the transition point will be made automatically.

The common type of sub-cooler section is one which extends the

full length of a horizontal heater, covering as many tubes as are required to give the necessary heat transfer surface. Since the amount of heat transferred per square foot of sub-cooling section is less than that transferred in the condensing section, the water in part of the tubes at the return bend will be at a different temperature from that of the rest of the tubes.

This is illustrated by Fig. 1, which shows a plot of water temperatures along the tube length. It will be noticed that in those tubes which pass through the sub-cooling section the temperature difference between water and steam at the return end is four times as great as in the rest of the tubes. Since the temperature of the water leaving the heater is an average of the temperature from the two sets of tubes, it is obvious that a large portion of the tubes is working at temperatures very near the steam temperature at low heat transfer, and as a result the amount of surface required is unnecessarily increased.

Figure 3 shows the design which is used on Westinghouse desuperheating and sub-cooling feedwater heaters. Instead of using a portion of the tubes as a sub-cooler, a fraction of the length of all the tubes is separated off by transverse partitions so that the temperature of the water is the same in all tubes at any cross section of a heater pan. Fig. 2 shows the temperature plot for such a feedwater heater.

It will be noticed that a given outlet temperature can be attained with a much smaller minimum difference between steam and water temperature than was possible with the other type of heater. The chief problem which arises in connection with the heater shown in Fig. 3 is sealing the cross baffle so that steam will not pass through it into condensate and prevent sub-cooling. This has been accomplished by using the condensate from the upper pass of the heater to form a water seal. The partition between the two passes has a dam on the reverse end to keep it flooded at all times, and the partition between the sub-cooling and condensing section is made of two plates with a slight space between them, this space communicating with the upper side of the pass partition.

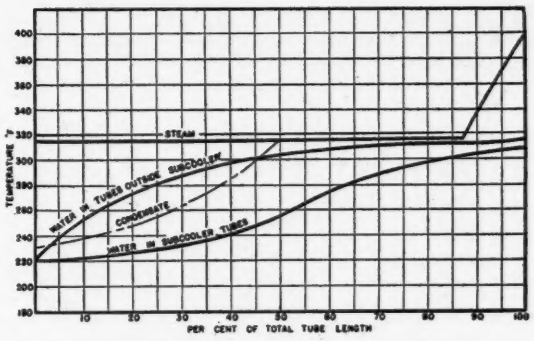


Fig. 1. Temperature chart of a feedwater heater with a full length sub-cooler for cooling the condensate

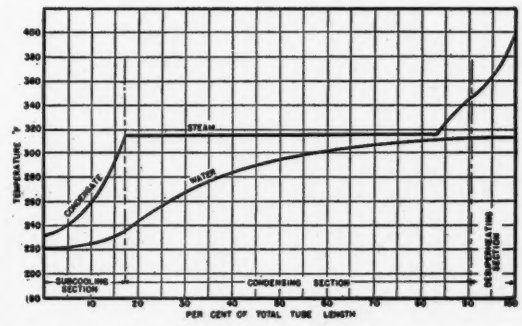


Fig. 2. Temperature chart for the feedwater heater shown by Fig. 3 with the sub-cooler at the inlet end

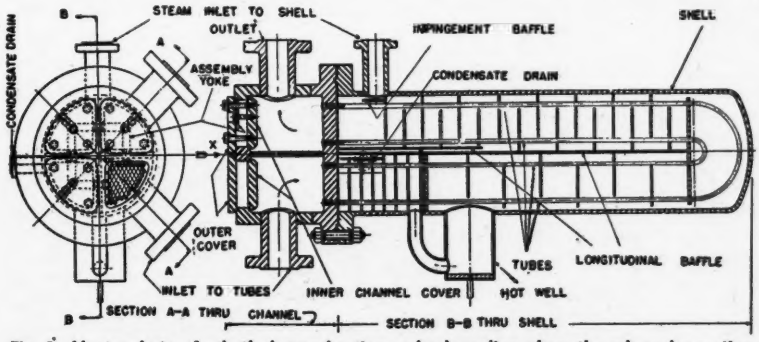


Fig. 3. Heater design for both desuperheating and sub-cooling where the sub-cooler section consists of a portion of all tubes. The section at the left is looking in the direction of arrow X with one outer and one inner channel cover removed from the same quadrant

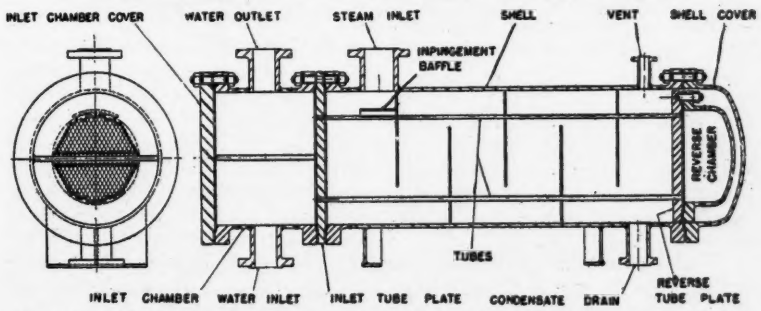


Fig. 4. The common low-pressure heater without either sub-cooling or superheating. Baffles direct the steam flow and support the tubes

Condensate is then fed down between these two plates so that any leakage into the sub-cooling section would be of this condensate rather than of raw steam. A hotwell is provided at the end of the condensing section to which a float, controlling a valve in the discharge from the sub-cooling section, is attached so that the condensing section will be kept drained at all times.

In this type of heater, as well as in the usual low-pressure feedwater heater shown in Fig. 4, the baffling is such that the possibility of air pocketing is eliminated. Cross baffles only are used to direct the steam from side to side and also to support the tubes and prevent vibration. Since clearance holes must be provided in these baffles around the tubes, they are not air-tight and any air collecting along the face of them will pass through due to the slight pressure drop caused by the flow around the baffle.

Practical Aspects of DAMPER CONTROL

Flow characteristics of nine different damper types were presented in an earlier article[3] based upon a paper presented at an A.S.M.E. meeting in Atlanta. This article deals with the practical aspects of the damper and damper mechanism as a control mechanism for some specific service

BY P. S. DICKEY[1] and H. L. COPLEN[2]
Bailey Meter Co.

WHILE DAMPERS are in almost universal use for controlling air and gas flow, limited data on capacities and the desire to keep the pressure loss low when the damper was open, favored the tendency to make dampers larger with little thought as to their regulating characteristics. A point which undoubtedly needs clarification is the meaning of a desirable flow characteristic in dampers.

When the damper is used in combustion furnaces for regulating the air-fuel or for regulating the furnace pressure, it is desirable that the change in rate of gas flow per increment change in opening of the damper be reasonably uniform from the tightly-closed position to the wide-open position. It is hardly possible to achieve this desirable result in dampers of conventional design, but, with proper consideration of the size and general form of the damper, a reasonable approximation may be obtained.

It is not uncommon to find installed dampers which cause a change in the rate of gas flow ten times as great, per degree of travel, at 10 deg. opening as at 60 or 70 deg. opening. This is bad for manual control since the operator cannot co-ordinate the effect and the cause and, hence, finds is difficult to obtain proper regulation.

It is bad for automatic regulation as the regulator cannot be properly stabilized for the sensitive portion of the damper and yet achieve the maximum effective speed at the insensitive portion of the damper. Dampers, especially in large sizes, are hardly precise mechanisms, but by allowing for a few fundamental considerations, a simple and inexpensive damper can be built with reasonable clearances and good regulating characteristics for either manual or automatic control.

[1]Director of Research.
[2]Research Department.
[3]June, 1941, issue, p. 58.

Mechanical Design

In selecting the most suitable damper design for a specific application, the designer must consider the following factors: Is the damper to be used for regulating purposes or for complete shutoff only? Is the duct in which the damper is located handling hot or cold gases? Is the duct handling gases under pressure or under vacuum? What size damper should be used? Should the damper frame be round or rectangular? Should single or multiple blade dampers be used? What provisions shall be made for mechanical and dynamic balance? What type of external linkage should be used for operating the damper?

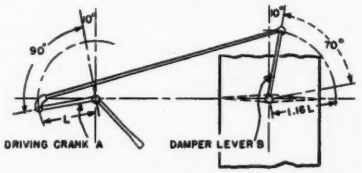
If a damper is to be used for shutoff service only, the two prime considerations are the leakage possibilities and the power required to operate it. If the damper is to be used for regulating service, the leakage may or may not be important, depending upon how much range must be covered. The power required for operation is equally as important with the regulating damper as with the one used for shutoff only. The flow characteristic of the regulating damper must be considered if proper results are to be obtained.

Dampers of conventional design are suitable for use in ducts where gas temperatures do not exceed 800 deg. F. They may also be used at higher temperatures if suitable allowance is made for the decreasing strength of materials at the elevated temperatures. For temperatures in excess of 1200 deg. F., the usual practice is to use gates built of refractory materials which operate in water-cooled slides.

In general, the clearance between the damper blades and the damper frame must be increased as the gas temperature increases, due to possible warpage of the ductwork and damper frame at the elevated temperatures. From tests[3], made on typical types of dampers having close clearance and large clearance, the effect of these on the flow characteristics may be determined.

For ordinary work, the damper, having a side and end clearance of 0.25 per cent of the cross-sectional dimensions of the frame, will give good results without excessive manufacturing cost. For higher temperature service, a larger clearance, say 2 per cent is preferable. It is believed that this added clearance will take care of any changes in the shape of the damper frame due to temperature variations.

Proper design of the damper shafts, shaft bearings and seals is



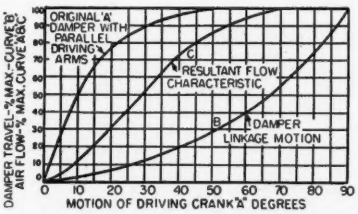

ORIGINAL 'A' DAMPER WITH PARALLEL DRIVING 'A' ARMS
C
RESULTANT FLOW CHARACTERISTIC
B
DAMPER LINKAGE MOTION
DAMPER TRAVEL-% MAX.-CURVE 'B'
AIR FLOW-% MAX. CURVE A&C
0 10 20 30 40 50 60 70 80 90
MOTION OF DRIVING CRANK 'A' DEGREES

Fig. 1. Curves showing the effect of linkage on flow characteristics. By means of the linkage shown above, the original damper characteristic A, with parallel driving arms is changed to Curve C

of utmost importance, particularly where the dampers are located in ducts in which the gases are under pressure and at high temperature, and where there is any dust present in the flue gas. Both the sleeve type and ball-bearing type have been used with good success, though it is important that either type of bearing be located outside the damper frame. It should also be spaced some distance away from it with a suitable seal at the point where the

damper shaft extends through the frame. Most bearing troubles are due either to misalinement or to hot gas or dust-laden gas being blown into the bearing through the opening between the damper shaft and damper frame.

In the smaller-size dampers, with rectangular or round frames, it is usually possible to provide frames of good rigidity, therefore, clearances may be small and leakage kept to very low values. A single-leaf damper, closing at right angles to the side wall, is the design which gives the best flow characteristic. There is no great difference between the area or flow characteristic of single-leaf dampers in rectangular or round ducts. Therefore, there is no reason for changing the shape of the duct at the point where the damper is installed until the duct size becomes large enough so that multiple blade dampers are required.

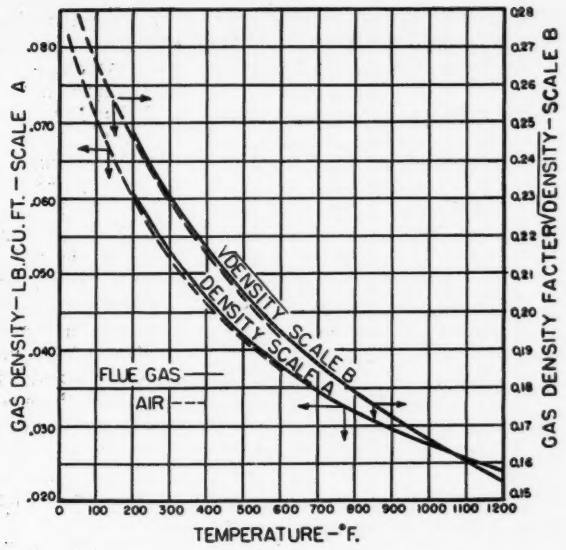


Fig. 3. Values of air and flue gas densities for temperatures up to 1200 deg. F. and on the right hand scale square root values for use in flow equations

Dividing Plates

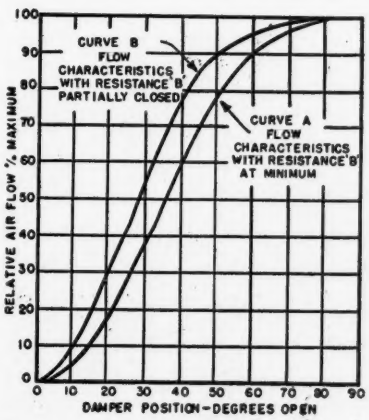
In the larger sizes, where it is not practical to retain the single-leaf construction, due to large values of torque obtained due to small unbalance of the blade area, it becomes necessary to divide the damper into a number of blades or louvers. To accomplish the desirable flow characteristic of the single-leaf damper, a partition can be installed between blades.

Use of this dividing partition not only gives a more desirable area and flow characteristic, but also provides a means of changing the over-all effective area of the damper after it is installed. In other words, if the damper is oversized it is possible after installation to block one or more of the louvers in the closed position and use only the remaining louvers for regulation.

Dividing partitions should be approximately the same length as the blade width to give proper results. The damper blade should be arranged to close at right angles to the dividing partitions as in the case of the single-leaf damper described. To overcome the increased leakage in the damper with the dividing partitions, because the blades cannot be closed against one another, side stops may be installed on the duct and on the dividing partition without seriously affecting the flow characteristic.

Another way in which to accomplish the flow characteristic of a single-leaf damper with multiple-louver dampers, is to arrange the external linkage so that adjacent blades rotate in opposite directions. The principal difficulty with this arrangement, however, is that it is difficult to close the openings tightly between the louvers, unless sealing strips are installed between blades.

There is no reliable rule for determining the proper number of louvers for a given-size damper. It becomes necessary, therefore, for the designer, in a given-size frame, to select the number of blades which will keep the width of each blade, and thus the possible unbalanced force, within the limits of the driving mechanism. At the same time, he must keep the number of blades and thus the possible leakage area as low as possible.



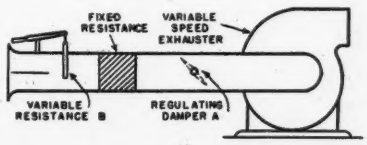


Fig. 2. When a damper is installed as part of a draft system its flow characteristic is dependent upon the total resistance of the system. Changing the fixed resistance changes the damper characteristics as, for instance, from Curve A to Curve B. Curves are from model test results with velocities ranging from 500 to 2100 ft. per min.

Balancing by Using Unequal Areas

Efforts have been made from time to time to obtain perfectly balanced dampers by adjusting the effective area of the blade on either side of the supporting or operating shaft. Such efforts are entirely justified as a means of reducing the torque necessary for operation, but as this is strictly a field job it is impractical for the designer to attempt to make a provision of this nature.

In most cases, force unbalance is caused by area unbalance or by some unpredictable stratification of the gas flow in the duct. In dampers having louvers of considerable size (particularly width) an unbalanced area, caused by variations in manufacture well within the tolerance for this type of equipment, may result in considerable force being exerted on the operating shaft.

No doubt there is some unbalance exerted by the variable pressures existing over the area of the blade on the downstream side, but this likewise is difficult to predict, in view of the lack of standardiza-

tion of damper types and sizes. Therefore, the best procedure for the designer is to strive for equal distribution at the areas of the damper blades and, if necessary, provide a balancing pendulum of suitable size on the outside of the duct. This may be used to offset any undesirable unbalance or to produce an unbalance in the opening or closing direction for those applications where this is desired.

When the desired flow characteristic cannot be obtained by using a proper size of damper, approximate results may be obtained by the use of angularity in the driving linkage. For example, if an operating linkage is provided as shown in Fig. 1 (and the driving crank A starts close to the dead-center position when the damper is closed) a motion characteristic is obtained which provides only 1/5 of the travel of the damper per degree motion of the driving crank at 10 deg. that it does at 80 deg. open.

This motion characteristic is shown in Fig. 1, and it will be noted that the motion characteristic compensates for the poor flow characteristic of the oversize damper, which is usually similar to that also shown in the illustration. However, when using a linkage of this type to overcome a poor flow characteristic, it is essential that all bearings and all pins in the linkage be free of backlash or of lost motion, otherwise all benefit of the retarded damper action near the closed position will be lost.

It cannot be overemphasized that the flow characteristics of a damper depend upon the ratio of the damper resistance to the fixed resistance of the system in which the damper is installed. As long as this external resistance is unchanged, the damper characteristic is fixed and is not materially affected by the gas velocity. However, this characteristic can be shifted by changing the external resistance.

For example in the system shown in Fig. 2, consisting of a fan drawing gas from a point of fixed pressure through a resistance, such as a heat-transfer surface, when a damper A of a definite size is installed in the system, its characteristic is fixed as shown by Curve A.

Changing the volume of gas, or, in other words, the velocity through the system does not affect the flow characteristic in any way. At each damper setting the percentage of the maximum flow at a given fan speed is essentially constant.

However, if the fixed resistance of the system is changed, or if an additional resistance is added to the system, as may be done with the gate B in Fig. 2, the flow characteristic of the damper is changed even though the fan speed is adjusted to restore the maximum velocity through the duct to the original value. This new flow characteristic curve is illustrated by Curve B in Fig. 2.

Now, if the new value of resistance, obtained by adding that of gate B to the original fixed system resistance, is not changed, the flow characteristic shown by Curve B is fixed and will retain the same shape even though the velocity is adjusted, by changing the fan speed over the entire range.

The foregoing statements need to be qualified as they are dependent upon the use of a fan which has a flat pressure characteristic or, in other words, one which maintains a constant pressure at a given speed regardless of the capacity.

The fan characteristic can ordinarily be disregarded in predicting approximate flow characteristics of different types of dampers in typical applications. The fan characteristic will not seriously change the damper characteristic and the important thing is to get the right type and size of damper for a specific application, the complication of incorporating fan characteristic to obtain precise results is seldom justified.

For boiler work the actual quantity of air and gas which the damper or dampers must handle is not difficult to calculate but is too involved to be considered here. On a thousand pound of steam per hr. basis it depends upon: the steam temperature and pressure; the feedwater temperature; the boiler and furnace efficiency; the fuel used; and the excess air ratio necessary or advisable in operation. When the gas or air quantities are substituted in either the flow or pressure loss equations[4], density must be considered. Inasmuch as this varies with the temperature Fig. 3 is included. This gives the density and square root of the density of both flue gas and air for temperatures up to 1200 deg. F.

[4]Eq. 1 and 2 of the June, 1941, article by the same authors.

Pioneer Hydro Plant Modernized

One of Illinois' pioneer water power developments, dating back to 1837, modernized by the Moline Water Power Co. with a new dam and power house. Four Kaplan wheels, driving 1125 kv-a. generators replace twenty 200-hp. old vertical geared wheels installed in 1897. The power plant and turbines are owned by the Moline Water Power Co.; and the generators and switchboard by the Moline-Rock Island Mfg. Co. which purchases the output

IN THE SHADOW of Rock Island Arsenal, the Moline Water Power Co. modernized its hydro plant. The job is of particular interest for several reasons: the method of handling the new construction with minimum interferring with the old equipment; the new plant itself; and, not the least, the fact that the plant site is one of the oldest water power developments in Illinois and one of, if not the, first plant in America to utilize draft tubes for improving turbine efficiency by recovering a portion of the leaving loss.

The dam being removed was built in 1897-8 and its location in respect to the Mississippi River and the Tri-Cities is shown by Fig. 2. This was an ell shaped structure of 31 bays. Twenty 200-hp. open setting vertical wheels were installed, six geared to each of three 1000-kw. generators, and each of the extra two driving exciters.

These 20 wheels have been replaced by four S. Morgan Smith four blade Kaplan wheels each driving a 100 r.p.m., 1125 kv-a., 4800 v., 2 ph., 60 cycle General Electric generator. The blades

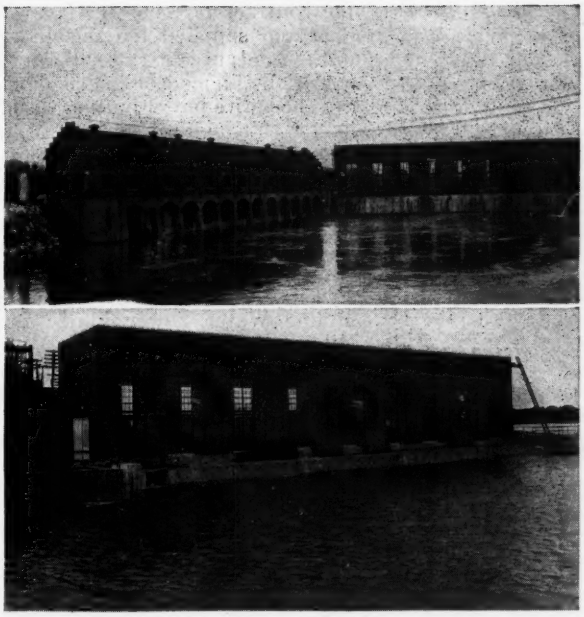


Fig. 1A. General view of the Moline Water Power Dam looking upstream from the Sylvan Slough tailrace. The old plant is shown at the left and the new power house at the right. The Moline steam plant of the Rock Island-Moline Mfg. Co. is just outside the picture at the right

Fig. 1B. View of the upstream side taken early in November from the Illinois side of the Moline Pool. A corner of the steam plant is visible at the extreme left

will not be adjusted automatically, but the governors will act on the wicket gates, under remote control from the nearby steam plant of the Rock Island-Moline Mfg. Co. Exciters will be motor driven.

The average operating head of about 12 ft. remains fairly constant for the pool level is controlled from Mississippi River Navigation Dam No. 15 slightly downstream. Roller gates were installed on the dam in 1934 and raised the average pool level about 2½ ft. The head is developed in the 12 mi. stretch of river between La Claire Rapids and Rock Island, where the natural fall per mile is about three times that in the stream above and below the rapids.

Details of the old and new dams are shown by Fig. 4. The new dam is located immediately behind the upstream leg of the old dam, and slightly diagonal. During construction this section was isolated by coffer dams upstream and downstream as shown. The six wheels and one generator were removed from the upstream leg and the exciter unit set up temporarily in the other wing of the building so that the remaining two generators could be kept in service.

Upon completion of the new plant, 12 bays of the old power dam were removed to allow free access of the pool to the new plant. If after inspection the remaining bays on the downstream leg are found to be in good condition, the wheels will be removed, settings and draft tubes filled with concrete, and the dam retained. Considering the condition of the upstream section, already partly demolished, there is little likelihood that any section of the north wing will have to be replaced.

Horizontal sections through the draft tubes and through the intake scrolls are shown by Fig. 4 for Units 1 and 4, respectively, while Fig. 3 shows a vertical section of the entire plant through the centerline of one unit. The concrete scroll cases and draft tubes are cast as an integral part of the substructure, with provision for unwatering the scroll cases by means of stop logs and drain valves. The trash racks are made up of 5 by ⅜ in. rustless steel bars set on 6 in. centers. A small steam boiler and five unit heaters are provided for heating.

The smaller insert in the upper left hand corner of Fig. 3 shows a section through the old dam and power house. This is of interest primarily because of the draft tubes, believed to be the first installed in this country for the purpose of increasing turbine efficiency by recovering a portion of the velocity head through the wheel. They were installed by S. S. Davis, president of the Moline Water Power Co., at the suggestion of Arnold Pfau, a young Swiss engineer in the Allis-Chalmers hydraulic turbine department. Mr. Pfau, from experience in Europe, was convinced of their intrinsic worth and Mr. Davis, an instinctive engineer, had already demonstrated an uncanny ability to spot worth while engineering achievements and back their commercial development.

He is the Tri-Cities utility pioneer; starting the Moline Water Works in 1883; installing the first lighting plant and insisting on a 35 lamp machine, 10 lamps larger than anything yet built; starting the gas works with a revolutionary new water gas generator; and in 1889 bringing the first electric street cars to the Tri-Cities.

Sylvan Slough on which the Moline Water Power Plant is situated is a back channel of the Mississippi and is not navigable for through traffic. The slough, and what is now known as Arsenal Island, come within the jurisdiction of the State of Illinois and in February 1837 the state legislature granted a charter for a water power development.

A low submerged dam and lateral wing dam were built, and taking advantage of a small head due to the natural fall of the river, sufficient power was developed to run a grist mill and saw mill. The charter changed hands several times and the scattered water rights were finally consolidated in 1865 in the Moline Water Power Co.

In 1864 Rock Island was taken over by the War Department for military purposes. Based on the recommendations of a commission appointed by Secretary of War, General U. S. Grant, a contract was entered into with the Moline Water Power Co. under which the United States assumed all future costs of maintenance and develop-

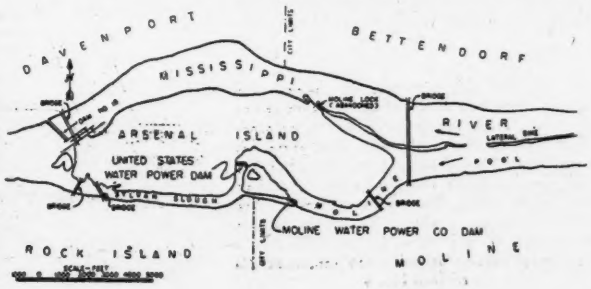


Fig. 2. Map of the Mississippi River at the Tri-Cities showing Arsenal Island, where the Army's Rock Island Arsenal is located, three dams and various bridges. A larger scale drawing of the Moline Water Power Dam is shown by Fig. 3

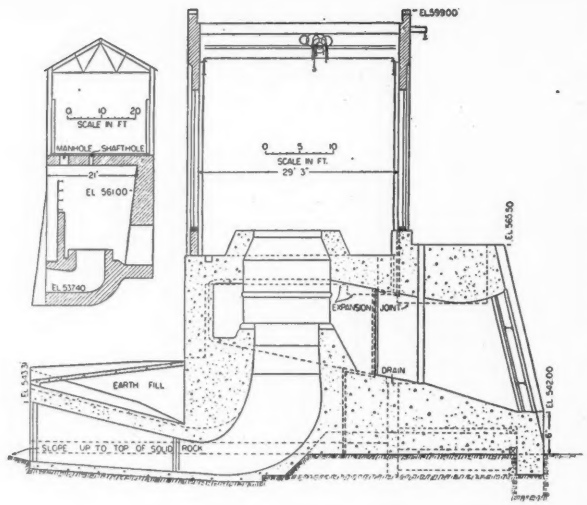


Fig. 3. General section through the center line of one unit showing the intake and draft tube. The portion of the dam upstream of the heavy dashed line is owned by the government. The small insert at the left shows a section through the old plant (½ the scale of the new). The old dam was built in 1896-7 and the draft tubes are thought to be the first used in this country designed to recover a portion of the velocity head leaving the wheels

ment of water power in Sylvan Slough and the Moline Company received a quarter of all power developed as full compensation for their rights and investment.

At the time the contract was negotiated, long before the days of electricity, power meant simply falling water, and the obligation of the government was only to provide a dam with suitable openings in which the Moline Water Power Company might install their water wheels to utilize their one-fourth of the available water. The dam now under construction is the third which has been built under the terms of that contract.

In the first dam, which was a long lateral structure paralleling the Illinois shore, power was transferred across the tailrace by means of rope drives from water wheels separated at rather wide intervals. The second dam, which is just now being abandoned, was built in 1896-7 and contained the first electric generating equipment used at the site.

Since the modern hydroelectric dam is a monolithic and somewhat complicated structure embodying draft tubes, wheel settings, power house, etc., and since the government's obligation under the contract was limited to the construction of a dam with suitable openings, a division of cost on this present structure between the government and the company was, of course, necessary.

This was accomplished by a contribution from the government of an amount equal to the estimated cost of constructing a simple gravity type dam with openings for passing the volume of water to which the Water Power Company was entitled under the contract. This portion of the dam is upstream of the heavy dotted line in Fig. 3. The company itself took the contract for constructing the dam and supplied the remainder of the funds necessary for the construction of a modern hydro plant.

The entire power output is sold to the Moline-Rock Island Mfg. Co. which installed the generators, switchboard and necessary transmission facilities to tie the plant in with their system. This system is supplied with power from five stations: the company's own steam stations, Moline and Riverside; the Moline Water Power Plant; the Milan (Ill.) plant of the S. S. Davis Water Power Co. on the Rock River; and the government hydro plant on Arsenal Island.*

In the reconstruction of the dam and design of the new power plant, Ralph D. Thomas & Associates of Minneapolis, Minn., were consulting engineers. Construction was awarded to the Fegles Construction Co. of Minneapolis for whom D. G. Underdown acted as Construction Superintendent. Elmer Reuther is superintendent of the plant for the Moline Water Power Co.

*The historical features of this development were supplied largely by the U. S. Engineer Office, Rock Island, Ill. The government's interest in this development comes directly under the Ordnance Dept. and is administered by the Commanding Officer of Rock Island Arsenal. For a number of years, however, the Engineer Dept. has handled the engineering and construction on the power development for the Ordnance Dept.

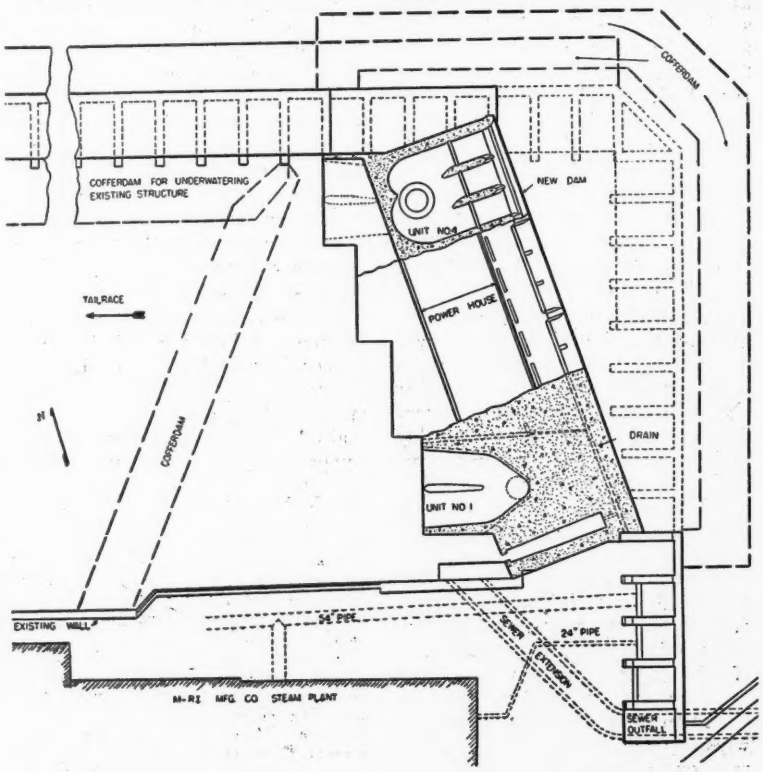


Fig. 4. The old dam was ell shaped and power house was built just downstream at the short leg. After the new dam was completed, Bays 5 to 16 of the old dam were removed. Bays 17 to 31 will be left in place, but the old wheels will be removed and the setting and draft tubes filled with concrete. The above drawing shows a horizontal section through the draft tube for Unit No. 1, a horizontal section through the intake scrolls of Unit No. 4

My Company vs. Our Company

Workers desire job security, good working conditions, proper tools, a chance to progress, partnership in work, vacations and recreational activities. Management should work in a spirit of sincerity, fair dealing, helpfulness and frankness, with a definite policy designed to build a spirit of "Our Company"

TO BUILD a sound organization calls for a sound, well defined policy as to relations between management and workers. To establish friendly relations calls for sincerity, consideration and fair dealing. From these will result stability and smooth operation of a plant, so essential to ensure the co-operative spirit needed in carrying out the defense program.

As a contrast in management, one organization with defense contracts had developed no policy for relations with the workers. When the rush came, it tried to raid competitive organizations for the expansion, gave large wage increases in 6 weeks, yet had large labor turnover and difficulties. There was no feeling of security or permanence and workers grasped any outside opportunity which seemed to offer betterment.

Define the Policy

Another organization had developed a training program and policy of promotion, with definite benefits to veteran employes and a policy of filling vacancies at the bottom and helping men to work up. The wages paid are lower than in the first company; no general advance has been made in the wage schedule, but nearly all older employes have been upgraded, and most workers are on a 60-hr. week with overtime above 40 hr., which means pay for 70 hr. or a 75 per cent increase in weekly pay.

Additions to the organization have gradually doubled the working force, mostly by additions to unskilled ranks, but promotion has been rapid. Average wages are, therefore, lower than for the first plant, but wages of older workers have greatly advanced. The company has secured and kept all the employes it needed. Sound, well defined policy, fair dealing and friendliness have helped.

This should be worked out carefully for the conditions of the organization as to size, product and workers. It should be based on a sincere desire to promote the welfare of the business and the workers and should be reduced to written form to give definiteness. In its original draft it will probably be used as a guide for major and minor executives, during a testing period as to satisfactory workability, and will be subject to revision as may be found desirable. The aim should be, however, to put it into workable form as early as possible and to publicize it by bulletins or posting, for the information of all workers.

Points to be covered in the policy should be:

1. Job classification and range of wages in each classification. Basis for promotion and wage increase. Basis for bonuses if any are to be given. Vacations.
2. Assistance to workers: In improving ability and preparing for better jobs. In cases of illness, accident, bereavement or financial emergencies.
3. Contact of major and minor executives with employes to discuss performance, improvement in equipment and methods, working conditions and employe grievances.
4. Plant rules, reasons for them and penalties for infractions.

Operating Program

Based on these policies, a program should be worked out for establishing harmonious relations between management and workers and esprit de corps in the organization. This involves education of all workers in understanding of the principles and program, the need for education being stated by Thomas R. Jones as, by officers and executives, supervisors and workers, in the order named. If executives, major and minor, understand and support the objects of the program, most workers will understand and appreciate the objectives aimed at.

Don Samson lists the desires of workers, beyond the common desire for good wages, and emphasizes that management should check its program to make certain how well these desires are given attention.

Security of Job. This covers fair play in retention and promotion, with recognition of good work and constructive criticism of faults. Group insurance, covering death benefit and care during illness. No favoritism in work allotment, promotion or layoff. It is largely a matter of proper spirit of supervisors toward workers, but should allow for discussion with a major executive of any question raised by a worker.

Good Working Conditions. Safety, good lighting, cleanliness, freedom from needless discomfort are essentials, if workers are to do their best. It is a function of management and supervision to see that these are provided and maintained.

Proper Tools. Unless tools suitable for the work are provided, both power-driven and hand-operated, workers will have a sense of irritation and will feel that they cannot get best results. Proper tools, kept in good working condition, will increase production. Suggestions by workers as to changes in tools and methods should be welcomed and rewards given for those used. Seemingly slight changes have often produced remarkable results in more and better work.

Chance to Progress. Help in preparing for the job ahead or in bettering performance in present work. Waiting sometimes seems irksome to younger employes and a discussion of chances of betterment and what will help to advancement is encouraging. Training courses, counsel by supervisors, appreciation of good work, promotion when earned are the implementation of this feature.

Vacations. Vacations with pay are desirable. Length may well be standard, but some organizations find extra vacation time, based on length of service or as a reward for special accomplishment, are an appreciated incentive. Under present conditions, extra vacation time

without pay is not generally possible or considered advisable.

Partnership in Work. Workers like to know what's going on. As to orders, deliveries, company plans and prospects. They like to regard the bosses as friendly, interested in them, their work, and their progress. They appreciate praise and helpful suggestions, even friendly constructive criticism in the interests of the organization.

Co-operation in social and recreational activities helps to build personal acquaintance and good will. While suggestions, assistance and some financial backing may be desirable, organization and responsibility for such activities should remain with the workers, with no taint of paternalism or subsidization. Desire for and appreciation of such activities should be evident among the majority of the organization.

By cultivating a feeling of "each one for all and all for each one" the partnership atmosphere is created and it becomes "our company."

This "our company" spirit must be built from the top down by sincerity, fair dealing, helpfulness, frankness, to secure and retain the co-operation and loyalty so essential to successful, comfortable operation of an organization.

Pulverizer Capacity, Fineness and Moisture

Fine grinding improves combustion and reduces slagging, the author tells the A.S.M.E. at Kansas City. Undue moisture reduces mill capacity, but this can be counteracted to some extent by supplying hot air or flue gas to the mill. Excessive amounts of surface moisture can be reduced by proper coal bunker construction and operating routine in the boiler room

By A. C. FOSTER
Manager, Service Department
Foster Wheeler Corp.,
New York City

THROUGHOUT the history of pulverized coal firing in steam generating units coarse pulverization and boiler entrance slagging have gone hand in hand. The effect of fine grinding on both combustible loss and slagging of the boiler entrance and superheater is more noticeable with the low grade, low ash fusion temperature coals than with the better coals.

The smaller the particle the more certain it is to be cooled throughout by the time it passes into the boiler and superheater. Likewise, since the loss due to unburned combustible is reduced by finer grinding it means that we have fewer particles reaching the boiler and superheater while still burning.

There are, of course, economical limits beyond which finer grinding may not pay dividends. These limits are not always easily defined. Finer grinding increases power consumption. In addition to the savings resulting from decreased carbon loss there are the more or less intangible savings resulting from the reduction in cleaning labor, steam, etc.; the improvement in net overall efficiency due to reduction in soot blower operation and time for hand lancing. The value of the reduced outage time for cleaning and the resulting increase in availability may be worth more than all of the above savings put together. This is something that can only be determined by each individual plant.

The free burning Midwest coals may easily be burned with a carbon loss of less than 1 per cent, with a fineness of about 70 per cent through 200 mesh. Nevertheless, experience has indicated that the fineness may advantageously be as high as 80 to 85 per cent through 200 mesh, in order to minimize boiler and superheater fouling.

High moisture content and low to moderate grindability influence the choice of coal preparation and pulverizing equipment. Specifications for pulverizers to handle Midwest coals usually require that the pulverizer be capable of handling 13 to 15 per cent moisture coal.

In all probability the moisture specified is the average moisture over some period of time. It may happen that when the installation is placed in operation the total moisture content is greater than specified. We have had occasions where it has been necessary to pulverize Midwest coals containing 19 to 20 per cent moisture. Should the mill output be limited because the moisture of the incoming coal is higher than was anticipated, an increase in the temperature of the preheated air to the mill will improve the mill performance.

If the air temperature is below 300 deg. F. the installation of a steam air heater to increase the temperature to somewhere in the neighborhood of 400 deg. F. is possible, provided steam at a pressure of 350 to 400 lb. per sq. in. is available. Such an air heater can usually be installed in the air ducts supplying preheated air to the mill.

Another method is to install a special primary air heater section on the gas side of the steam generating unit. This should be arranged so that the partially preheated primary air from the outlet of the secondary air preheater enters the primary air heater to be further heated by gases taken from a higher temperature region than those normally entering the secondary air heater.

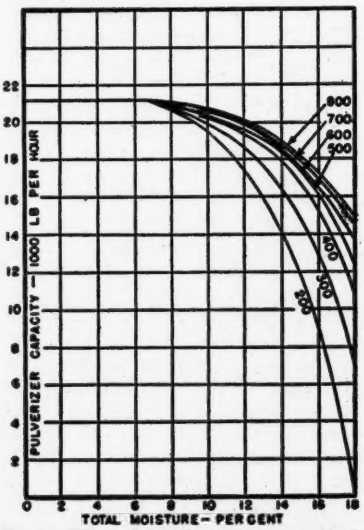


Fig. 1. Effect of initial moisture on conical ball mill pulverizer capacity with varying mill air inlet temperature and for midwest coals

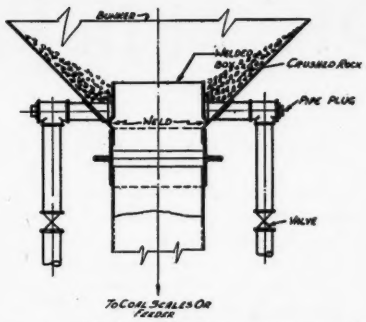


Fig. 2. Coal bunker or hopper arrangement to prevent run-off water entering the pulverizer

This makes it possible to increase the primary air temperature to 500 or 600 deg. F., depending upon the gas temperature available. It may prove advantageous to increase the temperature of the air going to the mill by mixing with the air a small amount of flue gas taken from a section of the boiler where the gas temperature is in the neighborhood of 1000 to 1200 deg. F.

Only a limited amount of flue gas can be mixed with the primary air. This quantity will depend upon the volatile and ash content of the fuel being burned and for Midwest coals will be about 20 per cent by weight. An excessive amount of flue gas added to the primary air may decrease the burner stability because of the inert gas present.

There is a limit to the improvement that may be expected from an increase in temperature of the air entering the mill. The law of diminishing returns sets a temperature of 600 to 650 deg. F. as the practical upper limit. This is shown in Fig. 1, where a series of curves shows the effect of raw coal moisture content on ball mill capacity with varying air temperatures entering the mill.

If we consider a pulverizer selected for a capacity of 18,600 lb. per hr., with a total moisture content of 12 per cent and an air temperature to the mill of 300 deg., it will be seen that an increase in raw coal moisture content to 16 per cent will reduce the mill output to about 13,000 lb. per hr. If an entering air temperature of 600 deg. is available the output will only be reduced to 16,500 lb. per hr.

Increasing the inlet air temperature from 600 to 800 deg. F. will only increase the output, with 16 per cent moisture coal, from 16,500 to 17,100 lb. per hr., a negligible amount. This same pulverizer will have the same capacity with 14 per cent moisture raw coal and 600 deg. F. entering air as it has with 12 per cent moisture and 300 deg. F. entering air. The effect of increased air temperature diminishes with decreasing raw coal moisture content.

Most operators have seen occasions when it has been necessary to operate with water running from the raw coal bunkers through the scales, feeders and raw coal conduits into the mill. These have been, of course, extraordinary conditions, but Fig. 2 shows a simple arrangement that can be installed in any coal bunker, to eliminate this condition.

It consists of a short addition to the coal pipe extending up into the bunker in such a manner that a trough is formed between this extension and the sides of the bunker. Suitable drain connections are provided, to drain off the excess surface moisture, which will collect in the trough. In plants where coal takes fire easily in the bunker, if not kept moving, the dead space between the extension and the side of the bunker may be filled with crushed rock as shown. This will also reduce the necessity for cleaning out the drain lines.

This device has been used in numerous plants, particularly in Canada, where large quantities of snow and ice find their way into the coal bunker during the winter. If, in connection with this moisture trap in the bunker, sufficient bunker capacity is available so that provisions can be made to allow the incoming coal to remain in a section of the bunker for a period of 24 hr. before it is fed to the mill, an appreciable reduction in the surface moisture content of the raw coal can be expected.

BETTER STREET light as the result of the aluminum shortage has recently been developed by Westinghouse lighting engineers. A new way to maintain quality was found in mirrored glass. Although reflectors for street lamps had never been made of silvered glass, it was found possible by new techniques to make one that would fit into a hood made of still-available sheet metal. The result is a fixture every bit as good in performance as one with an aluminum reflector—and better in some ways.

Because a clamping ring had to be used to hold the glass globe to the hood, the old aluminum unit used to cut off all light from the lamp above a 70 deg. angle with the vertical. The new glass-reflector has a cut-off angle of 75 deg., meaning that a much longer stretch of street can be lighted from single luminaires. The glass reflector also has a high reflection factor and can be returned almost to its original high reflecting power by simple cleansing, whereas, an aluminum reflector decreases somewhat in efficiency with the years.

FLUORESCENT LIGHTING ON RAILS

LIGHTING for the New York Central's new Empire State Express is at 60 v. supplied by generators driven from the axle through a Spicer Drive while cars are in motion. Separate windings permit operation from an external 220 v. a.c. source, as motor generators during stand-by periods with an automatic clutch to make the axle drive inoperative during such periods.

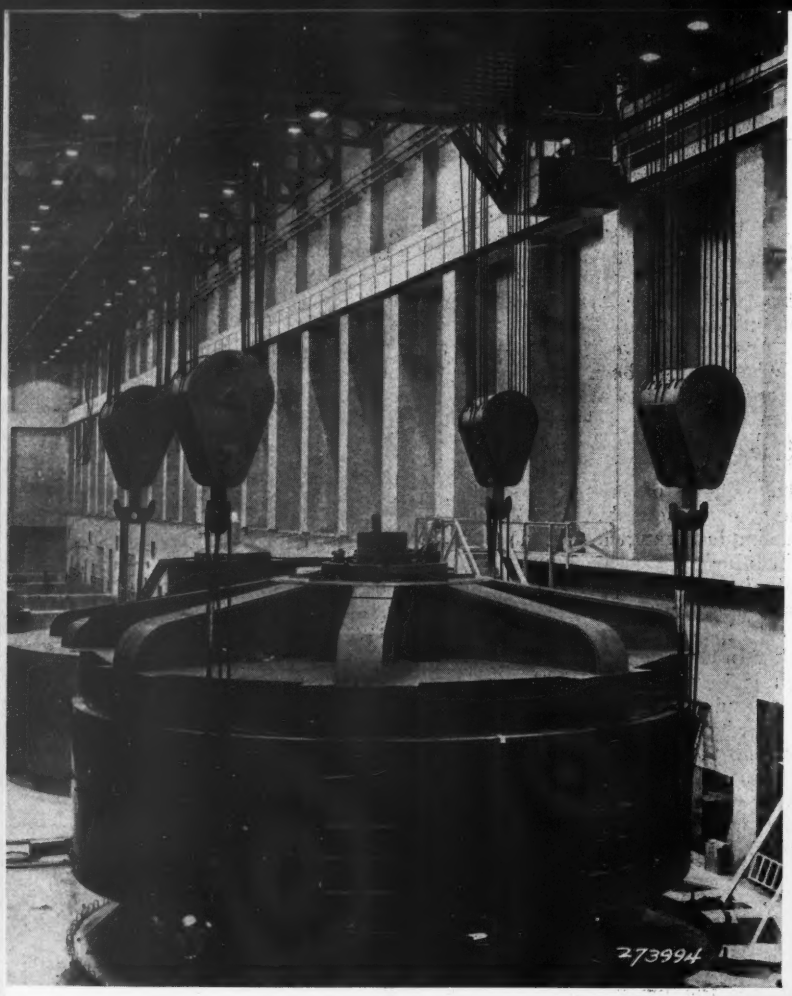
With the exceptions of incandescent ceiling fixtures in the coaches, parlor cars and diners and incandescent utility fixtures, 14 w. 15-in. fluorescent tubes are used. Fluorescent lighting on a 60 v. d.c. system is highly efficient because it entails no conversion to a.c. or voltage stepup with the resulting power loss. By the use of vibrators 110 v. a.c. is delivered to convenience outlets in the lounges.

Fixture design is based on not less than 10 ft. cp. at the reading level. In the diners and tavern cars the illumination is at a higher level.

In the baggage, tavern and observation cars, lighting is supplied from direct-indirect troughs on the sidewalls above the windows. Fluorescent tubes are arranged here so that direct light is cast down into the car and indirect lighting reflected from the wall and ceiling above. In both these cars fluorescent fixtures are used as decorative treatment at the bars.

Cars for the new Express, built by the Edward G. Budd Mfg. Co., are of standard stainless steel construction fabricated by the Shotweld process. There are 32 cars in all, forming two 16 car trains which will be hauled by streamlined Hudson locomotives. Each train will consist of one mail, one combination lounge, one observation, two diners and three parlor cars plus eight coaches.

PICTURES



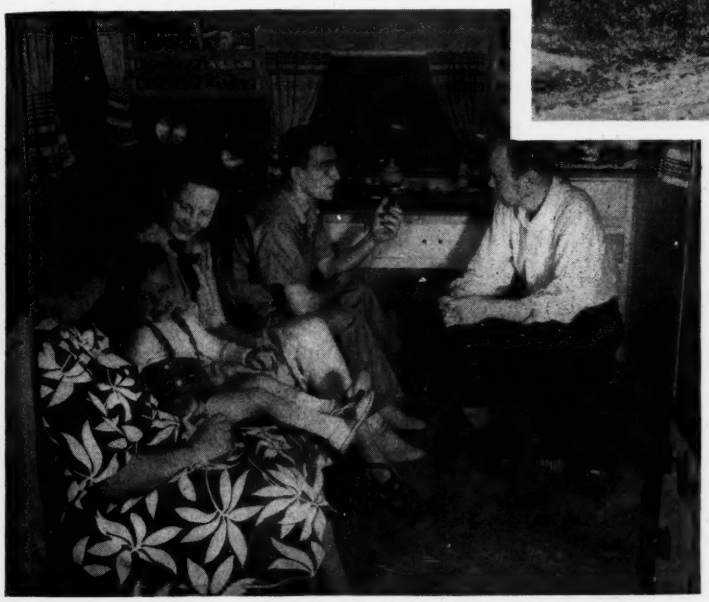
Second Grand Coulee generator is installed. This picture at the left shows the second of the eventual eighteen water wheel generators at Grand Coulee being installed. Built by Westinghouse, this particular 108,000-kw. unit was put in operation before the close of last year. The view shows the generator stator frame being lowered into position. All four hooks of the two great cranes are needed for this operation which, quite obviously, is a delicate one. Immediately behind is the first 108,000-kw. unit to be installed. This unit is already delivering power to the wartime industries of the Northwest. Work has begun on three more identical units to be installed in 1943. When all 18 machines are installed in the two power houses, Grand Coulee will have a total generating capacity of 1,944,000-kw.

At the right is a view in the turbine room of the Harding Street plant of the Indianapolis Power and Light Co. A new 37,500-kw. turbo-generator was installed recently. This unit is the one at the far end of the room. At the present time this unit can add about 17,000-kw. to the capacity of the station by using excess steam from the present boilers. When the new 400,000 lb. per hr. boiler is completed the full 37,500-kw. will be available

Power for Victory—TVA's Watts Bar Dam, in east Tennessee, is so far advanced that impoundment of the lake behind it will begin sometime this month with completion of the job scheduled for early 1943. This multiple-purpose dam will extend the navigation channel 72 mi. upstream, aid in controlling floods, and generate power vitally needed at the present time in national armament work. Nearby is the huge steam plant (described on p. 54 October, 1941 issue) rapidly nearing completion. It is shown in the lower left-hand corner. The steam plant will contain three units initially—total capacity of 180,000-kw.

# of Engineering Interest

Trailers House Armament Workers. While a New 500-home "War Village" was nearing completion adjacent to General Electric's Erie (Pa.) Works, additional workers hired to expedite the company's production of U. S. Army howitzers and turbines for destroyers and light cruisers lived in 250 trailers wheeled in by the government. G-E's Erie Works employs about 10,000, mostly on armament production, and in October was taking on new workers at the rate of about 150 weekly. Trailer rental is $6.00 per week, with complete laundry and lavatory facilities provided in centralized buildings



Life in the trailer camp does not seem so bad. As the picture at the left shows there is room enough to have the neighbors in, but someone may have to sit on an improvised chair. The thing which was best liked by many of the trailer-wives was that housecleaning was a one room proposition. All laundry facilities were provided for in special utility buildings. The camp was spaciously arranged with plenty of room for children to play in the fresh air and sun. In addition there was a large, fully equipped playground

Right. The beginnings of a new turbine. Here a huge forging which before long will begin to look like the rotor spindle for a large steam turbine is just beginning to receive its first machine operations on this big lathe at the Allis-Chalmers Mfg. Co. plant in Milwaukee, Wisconsin. This turbine will be one among many needed for "industrial war" purposes. This particular machine will be used in the manufacture of alloys needed in the manufacture of steel. It takes a lot of co-ordinated effort to turn out a big turbine. Completed this unit will represent some 101,000 man-hr. of labor

Rules for Revamping Small Plants

When plants become too small, too old or too inefficient to render good service several alternatives are possible. In some cases better operation will correct the difficulty. Sometimes they can be modernized at little expense; in others they must be completely rebuilt. The proper course can be determined only after close study, but the authors told the N. D. H. A. that these studies must be guided by certain generalized rules established from common sense and past experience. Part I deals with these generalizations, Part II with three case studies showing application of the generalizations to specific cases

By A. A. Cummins and H. N. Bernard
Consulting Engineers, Ann Arbor, Mich.

PROBLEMS attendant upon the generation and utilization of steam in institutional building groups and in small industrial concerns are not unlike those faced by small and moderate sized district heating companies. Boiler capacities become inadequate, boiler feedwater treatment systems fail to produce the desired results, buildings do not heat properly, and corrosion is to be noted in some places.

These types of plants are more or less regarded as "necessary evils." In general they operate upon a close budget and any important repairs or changes become possible only after special appropriations have been made. Those in direct charge of such plants have difficulty due to technological features to explain the need of changes and improvements in a manner which will convince executives with little or no engineering background.

Thus even though the plant operators know that undesirable conditions persist, they elect to overlook them rather than undergo the trials of attempting to explain them to a superior who more often than not is likely too be unsympathetic. This is especially true when maneuvering a special appropriation through the proper channels constitutes the first step in the solution of a problem.

Most of the problems embarrassing such plants revolve around one or more of the following considerations. 1. Total steam generating capacity when compared to the maximum steam requirement—not overlooking the outage of equipment from unpredictable causes beyond reasonable control. 2. Fuel—its availability, storage, economical use, and ash disposal. 3. Electric power generation as a by-product—not overlooking capital, maintenance, and operating costs, as compared with the equivalent purchased power. 4. The chemistry of water conditioning as it relates both to power plant use and corrosion in steam condensing equipment. 5. Wasting of steam used for heating purposes.

In the case of steam generating capacity, the accepted rule is that adequate capacity must always be available to satisfy essential steam requirements when one boiler is out of service. What constitutes essential requirements can be determined only by a study of local conditions. The maximum steam generating capacity of a boiler, however, should not be confused with its continuous generating capacity. Rarely can a unit be operated at a peak load for more than a short period, roughly 4 hr.

It is well to investigate the boiler plant at intervals to find out what can be done under the then existing conditions to improve efficiency. These improvements may be any of the following: 1. New fuel burning equipment. 2. Added water walls. 3. Added air cooled walls. 4. Added economizers. 5. Better feedwater. 6. Added instruments in order to better regulate performance. In making any improvements to old equipment careful consideration must be given to the probable remaining life of the existing boilers in order to assure sufficient length of life for the new equipment to justify the installation.

If additional steaming capacity is required then the decision should be made between revamping existing equipment to get additional capacity and installing a new boiler. This is a separate problem for each plant and the decision will be influenced by age of existing equipment, cost of changes as compared to the cost of new boiler, savings to be made in each case, rate of increase in plant steam load and money available for investment.

When space is available, the installation of a new boiler in an old plant, where the old boilers are becoming obsolete, presents the opportunity to begin a new complete set up, which, when it is eventually completed, will give a new installation, within the same space limits, of increased efficiency and greatly increased capacity.

Careful checks show that heat control equipment can be installed in many buildings that will pay for itself in 2 yr. or less from the steam savings. These savings in most cases, we believe, will run 15 to 20 per cent and in some cases where heating is being very badly handled, will run more.

Fuel handling and fuel economy present a perpetual problem in all plants. It is in this field, particularly in firing methods, that the most pronounced engineering advances have been made. It is in this field, also, that the most important savings can be made and that the urge to "over-engineer" is most pronounced.

Among small plant operators there is considerable loose thinking relative to the economy of by-product power generation. While in many cases it may be a profitable procedure, considerable care is necessary in selecting the proper size and character of equipment. Where steam can be reduced from boiler pressure to heating header pressure by passing it through a turbine or engine, instead of a reducing valve, mechanical or electrical power can be secured for approximately ½ lb. of coal per kw-hr. If coal costs $5.00 per ton the fuel cost would be 1¼ mills per kw-hr. There is, however, the investment

and operating cost of the engine or turbine to consider which may or may not make this practice a profitable procedure.

Water conditioning is probably the least understood feature in the operation of small stations. Although the difficulties in the use of boiler compounds, and the desirability of technical control have long since been demonstrated in large plants, it is generally true that the impression persists that "loose" methods still will suffice in the smaller plants.

By the easy expedient of retaining a competent chemist upon a part-time basis, equally as good conditions can be maintained in the small plant as in the larger ones. Paradoxical though it may seem, this procedure seldom entails any more expense than is entailed in paying the premiums usually included in the sale price of proprietary chemicals.

Combustion Calculations Simplified

Simplified calculations for liquid and gaseous hydrocarbon fuel combustion by means of the molal system

By Henry Cooney

FOR any given temperature and pressure a mol of any of the gases which enter into the combustion of gaseous fuels, represents a definite volume or number of cubic feet. It is obvious that the results of their burning may be expressed in cubic feet direct, thus simplifying calculations.

The following equations are given to illustrate this view:

1. Cubic feet O_2 required
   $= (C + H \div 4) + CO \div 2$
   (subtract O_2 in fuel)
2. Cubic feet of N_2 accompanying oxygen
   = No. 1 × 3.78 (Add N_2 in fuel.)
3. Cubic feet of air required
   = No. 1 + No. 2
4. Cubic feet of CO_2 produced
   = the number of C and CO atoms. (Add CO_2 in fuel.)
5. Cubic feet of H_2O produced
   = ½ the number of H atoms
6. Cubic feet of dry gas produced
   = No. 2 + No. 4
7. Per cent CO_2
   = No. 4 ÷ No. 6 or (No. 4) ÷ (No. 4 + No. 2)

These equations as applied to butane (C_4H_{10}) in the same order give the following results.

O_2	required	= 6.5 cu. ft.
N_2	required	= 24.57 cu. ft.
Air	required	= 31.05 cu. ft.
CO_2	produced	= 4.00 cu. ft.
H_2O	produced	= 5.00 cu. ft.
Dry product		= 28.57 cu. ft.
CO_2		= 14.00 per cent

Table I shows how these equations are applied to a retort coal gas.

Table II shows flue gas analysis for different CO_2 values.

The first line of figures in this table is calculated directly from the final volumes of Table I. Other values of CO_2 are assumed. When this is done the corresponding percentage of O_2
$= 20.9 - 1.868\ (\%\ CO_2)$
and the dry volume is equal to $50.3 \div \%\ CO_2$.

Table I. Calculations for a retort coal gas made by using the equations given in the text

		CO_2	O_2	N_2	CO	H_2	CH_4	C_2H_4	C_6H_6	Total
Analysis of 1 Cu. Ft.		.015	.003	.035	.086	.525	.314	.011	.011	1.000
Required for Combustion	O_2		−.003		.043	.262	.628	.033	.083	1.046
	Air		1.046	3.956						5.002
Products of Combustion	H_2O					.525	.628	.022	.033	1.208
	CO_2	.015			.086		.314	.022	.066	.503
	N_2			3.991						3.991
	Dry	.015		3.991	.086		.314	.022	.066	4.494

Table II. Calculation of the flue gas analysis for various percentages of CO_2

PER CENT BY VOLUME OF GASES			Dry Vol. Cu. Ft. from burning 1 Cu. Ft.
CO_2	O_2	N_2	of Gas
11.19	0.00	88.81	4.494
10.00	2.23	87.77	5.030
9.00	4.10	86.90	5.588
8.00	5.97	86.03	6.288
7.00	7.83	85.17	7.186

The following equations are designed for liquid[1] hydrocarbon fuels. If the basis of calculation is 100 lb. of fuel, and H = lb. hydrogen, then 100 − H = lb. of carbon. Since the atomic weight of carbon is 12, then $(100 - H) \div 12$ = mols of CO_2 in the flue gas and also the mols of O_2 necessary to burn the carbon. Also $H \div 4$ = mols of O_2 necessary to burn the hydrogen. The air required to burn 100 lb. of fuel is then

$$\left[(100 - H) \div 12\right] + (H \div 4)$$

Since the ratio of O_2 to N_2 in the air is 1 to 3.78, the mols of N_2 in the flue gas is

$$3.78 \times \left(\frac{100 - H}{12} + \frac{H}{4}\right) \ldots \text{Eq. 1}$$

The maximum CO_2
$= CO_2 \div (CO_2 + N_2)$

Substituting the above values in this equation and simplifying

$$CO_2 = \frac{100 - H}{478 + 6.56\,H} \quad \ldots\ldots\ldots \text{Eq. 2}$$

[2]Bureau of Standards Publication No. 97 gives the following equation for determining the percentage of hydrogen of a fuel.

$$H = 26 - 15\,d \quad \ldots\ldots\ldots \text{Eq. 3}$$

Where H = per cent hydrogen by weight and d = specific gravity.

With Eq. 3 for H and Eq. 2 for the max. CO_2 it is possible to obtain a relation between the A.P.I. gravity of the fuel and the ultimate CO_2.

Example: If the A.P.I. gravity of a fuel oil is 28.5, the specific gravity is 141.5 (131.5 + 28.5) or 0.8844. Then

$H = 26 - (15 \times .8844)$ or 12.734, and substituting in Eq. 2

$$\frac{100 - 12.734}{478 + (6.56 \times 12.734)}$$

= 0.155 or the ultimate CO_2 in per cent is 15.5.

[1]See article by Paul F. Mark, Refiner and Gasoline Manufacturer, February, 1932.

[2]Obtainable from the Supt. of Documents, Government Printing Office, Washington, D. C., for 15 cents. Bureau of Standards Miscellaneous Pub. M97.

Pump and Bearing Lubrication Practice

Current practices and problems of an industrial plant described before the A.S.M.E. Surveys determine the proper type and quantity of lubricant and aid preventive maintenance. Lubricant requirements for pumps, relubricating ball bearings with hypodermic needles, detecting incipient failure by noise, effect of temperatures on oil service, viscosity and life

BY VIRGIL M. PALMER and CHARLES L. POPE
Eastman Kodak Co.
Rochester, N. Y.

SOME YEARS AGO an industrial lubrication program[1] was undertaken by the Eastman Kodak Co. Briefly, this program provided for standardization of lubricants through analysis of the lubrication requirements of the plant. Specifications were developed and issued through the material standards department to the plant personnel and vendors of lubricants.

This enables the purchasing department to reduce the number and control the uniformity of lubricants purchased. The reduction in numbers of lubricants materially simplified the receiving, stocking, dispensing, and applying of lubricants. Standard laboratory tests were established to insure that the physical characteristics of lubricants submitted for approval and lubricants received on specifications complied with the established standards.

Lubricants meeting the specifications were approved only after extensive test under service conditions. The reduction in the number of lubricants used afforded the opportunity to schedule their application as to frequency and method. The lubrication surveys have been continued and extended. We have found that in specifying the quantity and frequency of lubrication minimum feeds should be used only where adequate controls are available, as there is no factor of safety when running on the minimum quantity of lubricant.

On the other hand lubricants should not be wasted through fear of bearing failure or through the old but false notion that if enough is sufficient more will be beneficial. No difficulties will be encountered if the lubrication requirements are fully analyzed and followed. It will be found that such controls prevent contamination of product from overlubrication, failure of bearings from underlubrication, and waste of lubricants.

Pumps

Experience with the performance of lubricants has proved that service can be scheduled as to the amount of lubricant and frequency as shown by the following example: Many reciprocating steam pumps of various sizes were scattered throughout the plant and there was a lack of uniformity of oil feeds for pumps of the same size when individual oilers determined the quantity of oil required. The pumps operate on 70 lb. saturated steam.

Figure 1 was prepared and put in the hands of each maintenance man so that the proper supply of oil could be furnished any pump, from a 4 by 4 in. to an 18 by 18 in. size. The basis of the chart is 1,500,000 sq. ft. of area rubbed by the piston per gallon of oil.

Experience has shown that small-size pumps require relatively slightly more oil. It is believed that this is caused by the relatively large ratio of valve and piston-rod areas to area rubbed by piston. Use of this chart resulted in cleaner return lines to the boilers and lessened the amount of oil to be removed from the return feedwater. This same procedure is applied to steam, air, and refrigeration cylinder lubrication with modifications.

Ball Bearings

Suitable oil-level indicators are used on all gear cases and oil-lubricated ball- and roller-bearing housings. This prevents too high an oil level with consequent churning and aeration of the oil which results in higher temperatures and excessive leakage and increases the rate of breakdown of the oil due to oxidation.

Overloading bearings with grease results in excessive leakage, contamination of product, and waste of time and lubricants. Good practice for grease-lubricated antifriction bearings indicates that a bearing housing should be about one-third full of grease. This is a practice which is right in principle, but difficult to follow in the field.

One difficulty is that manufacturers do not state whether the bearings have been serviced with grease or have merely been slushed. Another difficulty is that the grease capacity of a bearing housing is unknown to the men charged with lubricating the equipment. We have therefore adopted the follow-

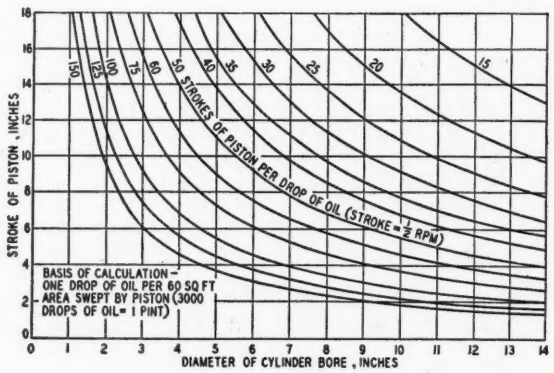


Chart for determining steam cylinder oil feeds for pumps operating on 70 lb. saturated steam

[1]Details of the program were given in an earlier A.S.M.E. paper presented by Virgil M. Palmer and Horace F. Smith and appearing on page 565 of the September, 1935, issue of Mechanical Engineering.

ing procedure in lubricating ball bearings with grease.

With the machine running, the bearing drain plug is removed and grease is forced slowly into the bearing until fresh grease starts to flow from the drain. The equipment is then run for 5 min. before the drain plug is replaced. This procedure has given satisfaction in the field and is a practical method of preventing overgreasing.

It is common practice to flood plain bearings with lubricant when they overheat. This practice is often carried over to ball and roller bearings by mechanics, with consequent overlubrication which results in still higher temperatures. In starting up new equipment, we have noted bearing temperatures as high as 235 deg. F. drop back to within a few degrees of room temperature when the drain plug was removed and the excess grease permitted to run out.

If ball bearings are kept clean, they require little lubrication. We have lubricated about 4000 ball bearings without seals, 2 in. outside diameter, turning at 200 r.p.m. and operating at a temperature of 140 deg. F., with 1½ c.c. of grease per bearing applied at 3 yr. intervals. This practice has been successful in preventing migration of lubricant from the bearing. The bearings are cleaned and then relubricated by means of a hypodermic needle in an air conditioned room.

Bearing failures are accompanied by an increase in the running temperature or by a change in the character of the sound. Experience has shown, however, that when there is a change in sound of ball or roller bearings, failure is imminent. The surfaces of the balls and races increase in roughness as bearing failure progresses, causing vibration of a different nature.

To detect incipient failures, we now use a sound recorder periodically on all critical equipment. This apparatus detects the slightest vibration in equipment which permits us to anticipate ultimate bearing failure, so that the bearing can be replaced on a scheduled shutdown of the equipment.

Oil or bearing temperatures do not always indicate the highest temperature to which the oil is subjected. Localized hot spots in bearings or circulating systems are easily overlooked although they are responsible for accelerating the rate of breakdown of a lubricant.

As an example we have roller bearings rotating at less than 10 r.p.m. bath lubricated with a turbine oil having a viscosity of 120 SSU at 210 deg. F. Bearing and room temperatures are between 95 and 100 deg. F. The oil acquired a burnt odor after only 4 wk. of operation. Analysis of this lubricant showed that the oil had oxidized to a marked extent.

The breakdown was apparently due to sustained high pressure and localized high temperature between bearing rollers and races in the load area. This same oil will operate over 4000 hr. in ring-oiled bearings of steam turbines at 175 deg. F.

High-temperature operation does not always indicate the need for high-viscosity oils. If the temperature is induced, there is some justification for their use. However, in equipment such as hydraulic presses, variable-speed drives, and circulating systems, the temperature is caused by fluid friction which increases with viscosity. Manufacturers of equipment often inadvertently contribute to unsatisfactory operation of their machinery by recommending heavier-bodied oils for their equipment when it is to be operated at high temperatures.

As an example, the oil in a hydraulic drive was changed from the oil recommended, having a viscosity of 300 SSU at 100 deg. F. to an oil with a viscosity of 150 SSU at 100 deg. F., with a consequent reduction in operating oil temperatures from 207 to 165 deg. F. From the A.S.T.M. viscosity-temperature chart it will be found that the oils had approximately the same operating viscosity and consequently they afforded the same protection to the equipment.

Another important factor influencing the performance and therefore the selection of the lubricant is the construction material coming in contact with the lubricant. Until recently, lubricants came in contact with copper, iron, steel, aluminum, and bronze only. Today, we also have synthetic plastics, monel metal, stainless steel, lead copper, cadmium silver, and many other alloys and metals.

In service, all petroleum products oxidize and form organic acids. Obviously, these acids attack some metals more readily than others. They destroy the bearing surfaces and form metallic soaps which contaminate the lubricant. Some of the metals and metallic soaps act as catalysts and greatly accelerate the oxidation of the lubricant.

Metals of different potential promote galvanic action. The lubricants which contain some organic acid and then pick up moisture become good electrolytes so that galvanic action can take place. Consequently, in lubricating equipment containing dissimilar metals, care must be taken to prevent excessive oxidation of the oil and the addition of moisture.

PIPELINE AND BOILER CORROSION

Corrosion in the steam water cycle of the average plant results from the presence of oxygen, said F. G. Straub before the M.P.C. Some few cases of acid waters cause corrosion but the majority of corrosion may be traced to the presence of oxygen. This means that in all steam plants, irrespective of pressure, it would be advisable to reduce the oxygen content of the feed water to as low a value as possible. Mechanical removal such as in properly designed and operated deaerating heaters is highly desirable. However, it is essential that these heaters be checked at regular intervals to see that they remove the oxygen under all conditions of operation. Since the gases must be vented out of the heaters, it is well to check the vents regularly so as to be certain that they are functioning properly. If the feed water has a pH value above 8.5, the feed water should not be corrosive. In many installations it becomes advisable to treat with chemicals to remove the last trace of oxygen or to remove any oxygen which enters the system at infrequent intervals. Chemicals such as sodium sulphite, ferrous hydroxide, finely divided iron, organic extracts, etc., are used for this purpose.

Many plants encounter corrosion in steam heat return systems, particularly when the return pipes are only partially filled with water. This occurs when the carbon dioxide content of the steam becomes appreciable. The carbon dioxide tends to form carbonic acid which in turn makes an acid condensate, and if there is any oxygen in filtration in the return system, very active corrosion results. The remedy of this trouble might involve, first, removal of the carbon dioxide (rather difficult for the average plant to do), second, neutralization of the acidity with a volatile alkaline material, or, third, change the piping so as to keep the pipes well drained or completely filled with condensate.

Hydraulic Couplings For Auxiliaries*

BY G. V. EDMONSON
American Blower Co.

With economy as the ruling factor in the selection of a variable speed drive for power plant auxiliaries, the hydraulic coupling has been adopted for this service during recent years with excellent results. Principles underlying this economy, a description of the hydraulic coupling and data on its application are included in the article

VARIABLE speed drives are used for certain power plant auxiliaries principally because of economy. The items included in this economy are (1) Power Saving, (2) Relief from Maintenance, and (3) Accurate Regulation of All Auxiliaries to Insure the Best Plant Operation. Simplicity of control of the variable speed unit is essential for satisfactorily accomplishing this third item.

Power Saving

Auxiliaries, selected on maximum volumes and pressures, require less input horsepower when their capacity is controlled by varying speed than any other type of capacity control. At any less condition of pressure at maximum volume, the power requirements of variable speed capacity control is more favorable.

Sound engineering practices require that certain, and often quite liberal, factors of safety be included in the calculations and specifications of auxiliaries. Actually, it is often found that the auxiliary is capable of delivering its required capacity, but against lower than specified pressures. This condition requires that the control function to reduce the speed of the auxiliary. Whereas throttle control of this auxiliary will require the driving motor to operate on the constant speed horsepower requirement which was fixed by the designed conditions, the excess head being absorbed by the damper, variable speed will require less input horsepower under these actual operating conditions, resulting in definite power saving.

Relief from Maintenance

Maintenance is a second item in economy to be considered. Variable speed control is favorable to reduced maintenance on the auxiliary which it is driving.

Whether it be a fan, boiler feed pump, or cooling water pump, its best condition of operation occurs when all that fluid which passes through the impeller flows from the casing with the least amount of restriction. It is also recognized that the least amount of turbulence, created by restriction to stream line flow, results in minimum amount of wear. Since the capacity of a unit varies as the impeller speed is reduced, it is possible to obtain capacity control by variable speed and without restriction of fluid flow, thereby setting up a condition favorable to minimum wear.

Under conditions of reduced capacity requirements where auxiliaries are controlled by variable speed, there is less tendency for high pitch noises and vibrations. These conditions with constant speed, throttle controlled apparatus exist apparently due to counter flows and reacting pressures. Variable speed adds an additional life factor for the unit bearings as wear is necessarily reduced at lower operating speeds.

Regulation of Auxiliaries

Accurate regulation of all auxiliaries to insure best plant operation is a third item in securing economy. It is of no less importance in producing the desired result.

Simplicity of control is essential. Capacity adjustment of an auxiliary, whether it is controlled by hand from the operating floor, or whether it is entirely automatic, must be accomplished with a minimum amount of effort and time on the part of the plant operator in order that he may be available for more essential duties. The variable speed unit must be adaptable to existing simple and well established methods of control equipment. It should be capable of a uniform degree of response over a wide capacity range. It should follow the demands of the plant operator or the automatic control, so that the system responds uniformly, thereby eliminating conditions of excess or too little capacity from one auxiliary as compared to what a second may be doing.

Automatic control functioning with variable speed is attractive in that, without introducing the human element, changes of load are accomplished without upsetting plant balance. The operator's function becomes one of periodic checking of results and a normal amount of maintenance work to keep his control equipment in the best working order. Fans and boiler feed pumps are the most discussed units with respect to variable speed of all power plant auxiliaries.

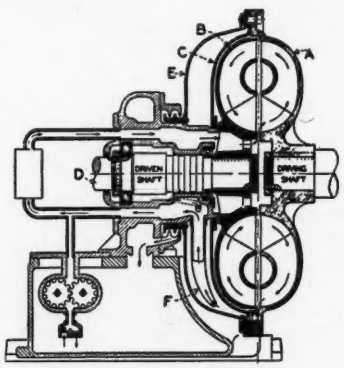


Fig. 1. Pump controlled variable speed hydraulic coupling

It is not uncommon for the capacity of a fan to be varied indefinitely over 80 per cent of its range. This varying demand of a fan requires that the variable speed unit be capable of an 80 per cent maximum reduction of speed and that it requires a minimum of power to handle this low load. The hydraulic coupling has been capable of producing these results. On the other hand, maximum change in capacity of a boiler feed pump is accomplished over a small range of speed adjustment from maxi-

*From a paper delivered before the Midwest Power Conference.

mum speed. Generally, 15 to 18 per cent speed reduction is sufficient to reduce the capacity of a boiler feed pump to a minimum. This requires that a variable speed unit must afford not only infinite increments of speed adjustment, but also possibilities of accurate control. The hydraulic coupling is likewise being used successfully on many pump installations, both large and small.

Principles of Hydraulic Coupling

The pump controlled type of variable speed hydraulic coupling (Fig. 1) is a unit consisting primarily of two elements, the impeller (A) and runner (B). Power is transmitted by a flow of oil from the impeller, which is driven by the electric motor to the runner which is connected to the auxiliary. The impeller imparts kinetic energy to the fluid by centrifugal pump action as it flows radially outward from the inside diameter of the section toward the outside diameter; the transmitting medium flows across the gap between the impeller and runner; and the kinetic energy stored in the transmitting fluid is released to the runner during its flow radially inward to the inside profile diameter. To change the speed of the output or runner shaft (D), which is connected to the load, with respect to the speed of the driving motor, the weight of fluid in the working circuit is reduced by the motor driven gear pump until the new capacity requirements of the auxiliary is satisfied.

An alternate arrangement of the variable speed unit is the Scoop Controlled coupling (Fig. 2). Instead of the oil reservoir being independent of the fluid circuit and oil for power transmission being transferred by a motor driven gear pump, the oil reservoir on the scoop controlled unit is bolted to and rotates with the coupling impeller and the oil is transferred to the working circuit by a lever controlled scoop whose nozzle position will vary on the coupling diameter and take from the rotating reservoir a quantity of oil necessary to satisfy the capacity requirement of the auxiliary.

The selection of a variable speed coupling should be based on the maximum designed horsepower required and transmitted at a loss in speed from motor to driven shaft of approximately 3 per cent. The fluid used in the hydraulic coupling

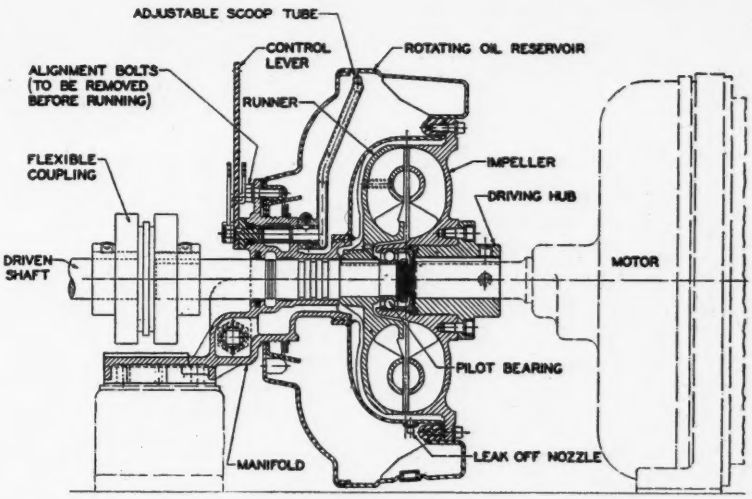


Fig. 2. Section through Scoop Controlled coupling

is a light mineral turbine oil having a viscosity of 150 S.S.U. at 100 deg. F. This fluid is used because of its lubricating qualities, availability and relatively low cost. Other fluids have been used successfully and are continually being explored, but turbine oil has been found to be the best fluid.

At the maximum speed of 97 per cent a loss in speed of 3 per cent exists. This per cent drop in speed is a direct indication of the efficiency of the coupling. To this loss in efficiency must be added a windage and pumping loss of the order of 1 per cent. In the hydraulic coupling every effort is made to streamline by use of smooth rotating parts and shrouding of bolts so that windage is reduced to a minimum. The pumping loss will depend on the quantity of the transmitting fluid circulated for cooling purposes.

Since the hydraulic coupling consists of only two rotating members, the torque output for all conditions of speed and filling is equal to the torque input and it follows that the efficiency is the per cent speed. Therefore, the efficiency at 75 per cent speed is 75 per cent and at 50 per cent speed is 50 per cent. To this loss in efficiency must be added the pumping and windage loss. Since the torque requirement of a fan varies as a square of the speed, it is seen that the power input to the hydraulic coupling being driven by a constant speed motor varies likewise and that the power loss is not a major item. The torque requirements of a constant head boiler feed-pump varies as a third to fourth power and the power input to the hydraulic coupling varies likewise. In addition, the speed range to accomplish complete capacity regulations of the boiler feed pump is narrow, therefore, the efficiency is high and the losses are low.

This loss in horsepower, however, at reduced speed must be carried away in the form of heat and the cooling system must be based on the maximum design conditions and sized for conditions at the point of maximum heat load. Large couplings operating at relatively low speeds have sufficient radiating surface to accomplish the necessary heat removal. On high powered units required for the modern power plant, however, additional oil cooling surface must be provided. A quantity of the transmitting fluid whose specific heat and weight are known is removed from the hydraulic coupling per unit of time. The heat is removed from the variable speed unit in the fluid to a cooler of the bundle tube type, similar to other condenser surfaces, whose total surface is determined to maintain a pre-determined maximum desirable oil entering temperature using the same cooling water whose weight and specific heat are known and whose temperature must be known in order that all equipment in the power plant functions at its designed efficiency. The heat which is transferred across the cooler surface and removed from the system is evidenced by a rise in the temperature of the cooling water. The cooling medium cannot be recirculated until the heat is removed, restoring its temperature to the initial point.

Fig. 1. Only one control to adjust speed on the new simplified drive. Here it is being used on a lathe at the Westinghouse East Pittsburgh Works

Series Circuit Simplifies Adjustable Speed Drive

BY S. H. HANVILLE
Motor Engineer, Westinghouse Elec. & Mfg. Co.

HIGH-TORQUE characteristics of a direct current series motor are combined with flat speed characteristics of a shunt machine in a newly developed series adjustable-speed drive. Having a continuously variable speed range of 10 to 1, it is far more flexible than adjustable-speed units employing wound-rotor motors.

The drive uses the variable-voltage principle, but employs a series-circuit that requires no exciter; consequently both control and wiring are simplified, and the system is more efficient than the ordinary variable-voltage system. It is suitable especially for direct connection to an alternating current power source.

This system has been applied to several different kinds of machines, some of which require adjustable speed from 1750 to 175 r.p.m. Typical examples are a 10-hp. unit on a printing press, a 10-hp. lathe drive, and a 1½-hp. unit driving a bottlemaking machine.

The series drive is started directly from the alternating current supply with a conventional across-the-line motor starter. Since voltage output of the self-excited generator builds up gradually under normal starting conditions, the driving motor is "cushioned" against mechanical shock. If the motor stalls it can produce a torque equal to six times full-load running torque, even at minimum speed. The standard drive is suitable for operation over a 10-to-1 speed range of from 1750 to 175 r.p.m., and it is possible to extend this to a 20-to-1 range for short-time operations, such as setting up and threading The motor will carry its rated horse-power at rated speed (usually 1750 r.p.m.) continuously without exceeding a 40 deg. C. temperature use. (Fig. 4) The units are suitable for continuous operation at speeds from

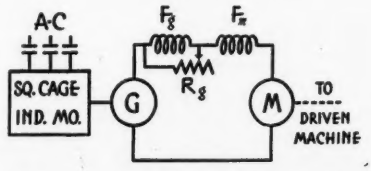


Fig. 2. Circuit of newly developed drive. Generator, driving motor, and their fields are in series. When rheostat Rg has maximum resistance, current through generator field Fg is maximum. Thus generator voltage is maximum, and motor M runs at maximum speed. As resistance Rg is decreased Fg is weakened, generator voltage drops and speed of motor M decreases proportionally

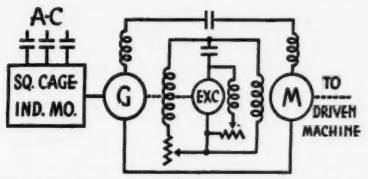


Fig. 3. Conventional drive needs exciter, more control apparatus. Losses of the exciter make this system less efficient

1750 to 175 r.p.m. at constant torque, without exceeding safe temperature rise.

The drive is not intended to replace conventional drives for applications such as planers, shapers, steel mills, and similar machinery requiring fast reversals, regenerative braking or accurate stopping.

Basically the newly developed series drive (Fig. 2) consists of three units: (1) a squirrel-cage induction motor operating from an alternating-current power source and mounted in the same frame with a series direct-current generator which supplies operating voltage for (2) a series motor connected to the driven machine. For speed control, there is (3) a low-resistance field rheostat. Only additional equipment required is a starter and pushbutton for the squirrel-cage motor. Where alternating-current power is not available, the generator may be belted, or connected directly to any suitable prime mover, such as a Diesel or gas engine, or a line-shaft.

Operation of the drive is similar in principle to that of the conventional variable voltage drive (Fig. 3), except that because the exciter is eliminated, it becomes somewhat simpler. It is started simply by pushing the "start" button. This closes the starter contactor, the motor-generator set comes up to speed, and the direct-current driving motor starts. Such smooth starting provides a magnetic cushion against shock to gears or to the driven machine. With a constant load on the driving motor, the speed of that motor may be changed by varying the resistance of the field rheostat, which varies the voltage output of the series generator. Once the desired speed has been set, any

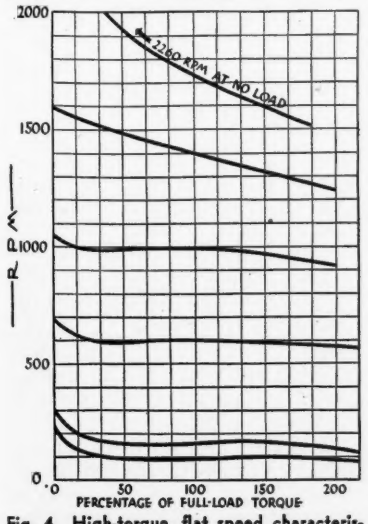


Fig. 4. High-torque, flat speed characteristics are combined in the series adjustable-speed drive. These curves are for a 10-hp. unit. No-load speed is 2260 r.p.m.

Typical Applications of the Simplified Adjustable-Speed Drive

Industry	Application	Horsepower Range	Operating Requirements
Aviation	Cranking aircraft engines	5-hp. intermittent rating	High starting torque
Cement	Conveyors	3–15	Constant speed for any speed setting
Ceramic	Lathe drives	1–7½	Adjustable speed
Chemical	Soap-making machines	15	Speed range 5 to 1; constant torque
Food	Bottling and packaging machines	1–5	Medium speed range; close adjustment
Lumber	Small log hauls	10–15	Frequent starting; high torque
Machine Tools	Lathes Milling machines Drilling and boring machines		Wide speed range; good speed regulation; dynamic braking
Materials Handling (all industries)	Feeder conveyors Assembly conveyors	1–15	Wide speed range 10 to 1; high starting torque
Metal Working	Casting machines	15	Same as conveyors
	Circle shear drive	1–15	Adjustable speed
	Spinning machine	3–7½	Adjustable speed; heavy torque at slow speeds
	Gear cutting	2–15	Adjustable speed; good regulation
	Cold saws	1–15	Adjustable speed
	Slotters	3–10	Adjustable speed; good regulation
	Key seaters	3–10	Adjustable speed; good regulation
Mining	Ore concentrators	1–10	Constant speed for any speed setting
Paper	Wire shakers	3–7½	Medium speed range
	Small slitters, winders and rewinders	3–15	Uniform speed and simple control.
	Special wet screens or savealls	3–15	
	Waxing machines		
Power Generation, Heating and Ventilating	Coal feeders	1–1½	Adjustable speed; constant torque; good regulation.
	Stokers	5–15	Wide range of speed; good regulation
Printing	Fan-fold letter press, web-fed rotary type	5–15	Nonreversing. Requires inching, dynamic braking
	Fan-fold offset press, web-fed rotary type		Same, except reversing
	Boxboard presses	7½–15	Nonreversing; reversing inching; dynamic braking
	Boxboard printer and slotter	7½–15	Reversing
	Rotary web-fed aniline press	5–15	Nonreversing
	Small rotary web-fed multi-color letter presses	10–15	Nonreversing
Rubber	Tubing machines	5–15	Close speed control
Textile	Sanforizers	5–15	Wide speed range; good regulation
	Tenters	7½–15	Same as for sanforizers
	Dry cans	7½–15*	
	Starch mangles	5–10*	
	Padders	3–7½*	*When driven individually
	Winders	1–5*	

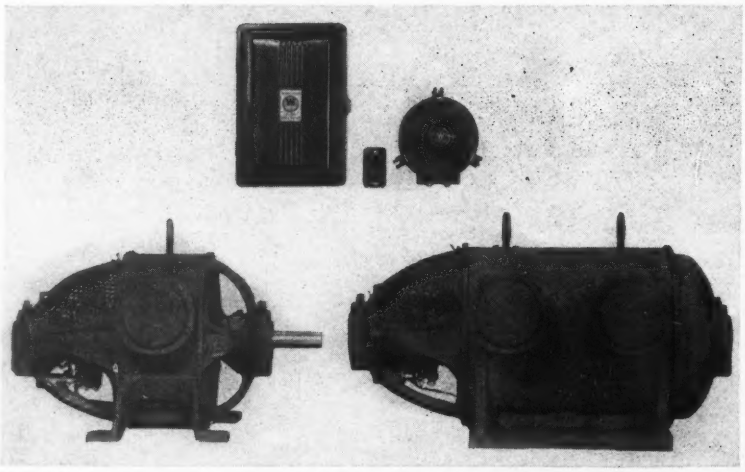


Fig. 5. The new Westinghouse adjustable speed drive. These five units form the complete drive including control

tendency for load to increase or decrease causes a corresponding increase or decrease in field current because the fields of motor and generator are in series. This raises or lowers generator voltage, partially compensating for IR drop and armature reaction, thus tending to maintain a constant speed.

If the application requires it, dynamic braking and inching can be incorporated in the circuit without using an external braking resistor. Braking is accomplished by a so-called "self-energizing braking field" which is no more than a separate series field wound on the same shell as the series field coil of the motor. Besides making external braking resistors unnecessary, the resistance of the field limits the braking current to a safe value. In operation, when the braking contactor is closed, the motor is disconnected from the generator and the braking field is shunted across the armature of the series motor to produce a magnetic effect opposite to that normally produced by the motor's series field. This brings the motor to a quick, decisive stop. Only extra equipment necessary for dynamic braking is an auxiliary braking contactor mounted near the alternating-current motor starter and electrically interlocked with it. If desired, braking torque may be varied by an external variable resistance.

Inching Operation, If It's Needed

When dynamic braking is employed the addition of a momentary-contact push button to the regular start-stop pushbutton station provides an inching control. The inching button is electrically interlocked with the field rheostat so that the drive will inch only when the rheostat is set for slow speed. This prevents strain on both the driving motor and the driven machine.

Ability to inch becomes especially valuable when the drive is applied to machines where strip material must be fed through slowly at first, after which the speed may be increased for normal operation.

REFRIGERATING ENGINEER

Part XII. A cracked nut starts peculiar physiological disturbance, one not easily brushed off and it starts something. That "something" however has nothing to do with the disturbance that came afterwards when a Stillson gets mixed up with a gage glass. There is much commotion for a while and the love angle disappears in the ammonia fumes. Things quiet down nicely by the time the chapter ends

BY GEORGE HOLMAN

ON THE EVENING after purging the air and testing the gages you take June Frost to a party dance and don't get home until 5 o'clock in the morning, just in time for a short nap and belated breakfast before hiking off to work. The nap makes you feel worse than if you had stayed awake.

More to keep awake than to cater to any ambition of yours that day, you get out the broom and mop and start the long delayed plant cleaning. You begin at the ceiling and work down, washing everything that can be safely washed with soap and water and using the cleaning fluid on the motors and switchboard. You knock the thick ring of rust from the bottom of the condenser, and shut down long enough to check the condition of the rolled-in ends of the condenser tubes.

Next day you wash the lids over the cans in the brine tank, and the framework beneath them as well. A day or two later you clean the switchboard, shutting down each machine in turn to file the silver points of the contactors, most of which have been burnt to a rough and blackened surface.

In time you trace out the small ammonia leaks, finding five in the machine room and two in the tank room. Two of these leaks require a pumpout of the liquid line to repair. At these two leaks, both of which are at threaded joints, you find the female threads of the malleable iron fittings galled and broken. They look as if they wouldn't even hold mashed potatoes under a pressure of a fairly strong odor of garlic.

You are lying on the floor one morning trying to wirebrush the scales of rust from the bottom of the liquid receiver when you notice something which makes your skin creep. The oil blowdown connects into the condenser at a small

welded-on connecting tap. Into the connection a short nipple is screwed, and at the bottom of the nipple a flange joint into which another short nipple leading to the blowdown valve is screwed. The flange is held together by only two 5/8 in. machine bolts. And the nut on one of the bolts is cracked through and through to the threads.

A Cracked Nut Gets Action

At first you doubt your eyesight, and try to brush the crack off as just a streak of rust. But the crack doesn't allow itself to be brushed off. You touch it cautiously with a forefinger, then crawl gingerly out from under the receiver. You call up Frosty, and while waiting for him to come over, go and stand outside. If that nut should break off the bolt, what happened when you twisted the head off the flange screw in No. 6 cooler would be nothing to what would take place in the machine room. And to think that you have worked in that room over a month.

Frosty looks at the cracked nut, then gets to his feet. "That's one good thing about cleaning up a plant and keeping it that way," he says. "You can find and fix dangerous conditions before they cut loose. We'll pump out that receiver right away, and get a good nut on that bolt before it takes a sudden notion to give away. I can't see how it held these 5 yr. and better.

"Now about pumping out the receiver," Frosty goes on. "The cooling room coils will hold the most refrigerant. We'll stop the compressor on that system, prop open the solenoid stop valve and let the coils take all the liquid they can stand. To speed this operation up, you go around through the storage and open up all thermoexpansion valves wide. Keep a check on the number of turns of the stem you open each one so that you can set them back up to where they are now.

The valves open, you come back to the machine room. After an hour's wait, during which time the sharp freezing and ice making compressors operate normally, the liquid level drops until it hardly shows in the gage glass of the receiver. "Now you can let that solenoid stop valve close," Frosty advises. "The cooling room coils have about all the liquid they will hold.

"It will take several hours to evaporate that liquid out of the receiver," you comment to Frosty, then ask: "Couldn't we get an oxyacetylene torch and help it along? I've read something about that being done."

"That's a good idea, but we won't need it here," Frosty says. "Close that stop valve on the liquid outlet from the condenser. The bottom part of the condenser as far up as the equalizer line inlet ought to hold whatever refrigerant is left in the system, including this in the receiver. No, don't close the valve on the equalizer line yet. Wait until the gas pressure in the condenser forces all the liquid into the sharp freezing or tank coils. The high pressure will send the liquid into the coils much faster that way."

As soon as the pressure in the tank coils begins to drop Frosty tells you to close the equalizer valve. There is then not enough liquid ammonia left in the receiver to cause moisture to collect on the bottom of that vessel, as the pressure in it and in the sharp freezing coils and tank coils drops to zero. In less than 30 min. after closing the equalizer valve there is a new nut and bolt in the flange, and you have a cracked nut for a souvenir.

But the cracked nut is not the last trouble you have with the receiver. One day when you are at work in the tank room trying to unscrew a 4-in. pipe with a 36-in. Stillson, you are suddenly aware that June Frost is at the window of the machine room. "Yoo-hoo!" June calls. "Asleep on the job, I'll bet!"

The Result of Mixing Business with Pleasure

The end of the receiver on which the gage glass has been installed is slightly more than even with the tank room doorway. With a grin as wide as a superhighway and still holding the 36 Stillson, you swagger down the steps to meet your weakness. Just what happens when you pass the liquid receiver you are not sure about until afterward. But with ammonia crackling and spewing about you, you drop the Stillson and almost knock June down getting out the window.

Without pausing on the walk, you race to the door and look in. The gage glass on the receiver is broken, probably by the Stillson in your hand as you passed it, and a wet fog of refrigerant is spewing out around the bottom gland nut. You duck inside to get a gas mask, then duck back outside to put it on. Protected by the mask, you go into the room and across it to the receiver. The ammonia still spews; and when you start to close the gage glass valves, it spews much worse. You keep on turning, however. And once closed, the valves hold well.

That evening you go home by way of the Aurora and relate the incident to Frosty. "I thought that gage glass valves had ball checks in them to roll into place and stop the flow if the glass should happen to break."

"They're just supposed to," Frosty grins dryly. "That glass is in a spot pretty much exposed to breakage. Take my advice and keep those valves closed. It's no trick at all to open them and close them back whenever you want to check the liquid level."

The Layout at Aurora

While you are at the Aurora, you look around. On sight, everything is vastly different from the equipment of the Wholesome. The plant is much bigger, although it has only two compressors. One of them is vertical, much like the ones at the Wholesome. But otherwise it is quite different. It has four cylinders, and is double acting. The cranks are open and grease lubricated. It is driven by a two-cylinder horizontal cross-compounder steam engine. Off to one end of the machine room you see a boiler and the stoker feeding the furnace beneath it.

You move about, unconsciously tracing out the discharge line from the compressor. The line leads up to the roof of the plant and enters a stand of pipes over which a spray of water falls. An atmospheric condenser. Tracing a number of bleeder lines from the condenser, you find that they converge into a main liquid line running down to a vertical vessel. The gage glass on the vessel shows that it is a liquid receiver.

From the liquid receiver, you trace the liquid line to a hand expansion valve. Beyond the valve the line is insulated, and leads downward into a brine tank. You look in vain for an agitator. At last you wake up to the fact that the evaporating coils must be distributed through the tank in vertical stands between the rows of cans. The whole refrigerating system connected to the steam driven compressor is old, and betrays the great age of the plant.

The other compressor is completely modern, an almost new

(Continued on Page 83)

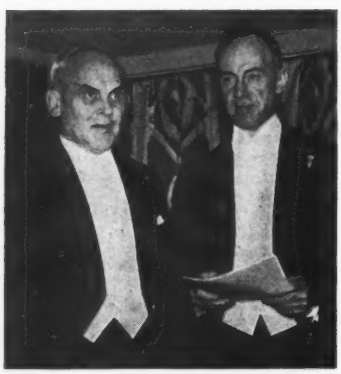
ASME Enters Battle Of Production

Sixty-Second Annual Meeting of the American Society of Mechanical Engineers held at Hotel Astor in New York, December 1 to 5, with nearly 3000 registered, reports progress in research, engineering and production

By Ralph E. Turner
Editor

THIS SIXTY-SECOND Annual Meeting of the A.S.M.E. took place during the week prior to the unexpected attacks of Japan on United State outposts, but attendance at any of the meetings left no doubt in the minds of those present that the engineers are going wholeheartedly into the battle of production of materials and equipment used in modern warfare, and among the members of the Society are many now in active military service.

American engineers have for years looked to this society for ideas coming out of research and experimental laboratories which they can adapt to the solution of their mechanical problems. Growing attention is being given to management and human problems, and the Society's activities along these lines are bringing public recognition to outstanding members. Government and military circles are now calling upon this profession for advice in this battle of production which is being waged to the limit of the country's industrial strength. There are, of course, many technical problems involved in carrying through the production of war materials which differ but little from those in peace time production and a number of the technical sessions of the meeting were devoted to such problems. What engineers as human beings are thinking about was revealed by the subjects discussed at luncheons, dinners and in the private conversations about the convention rooms.



C. D. Howe is presented an honorary membership by President William A. Hanley

At what was designated as National Defense Luncheon, Walter D. Binger, chairman of the National Technological Civil Protection Committee, who had but recently returned from England where he had investigated the work of civilians in bombed cities, gave his impressions of his visit in an address entitled "Lessons Learned from London."

President Hanley presided at a National Defense Symposium where research, design, invention and education for defense were discussed by such eminent authorities as Frank B. Jewett, Brig. Gen. G. M. Barnes, Col. L. B. Lent and Dean A. A. Potter.

Conservation and reclamation of materials used in industry have become such acute problems that a clinic was held to discuss the questions of interested engineers.

At the annual dinner the two principal addresses, "America Must Decide" by President Wm. A. Hanley and "Whither Industry—in Democracy's Arsenal" by Donald M. Nelson, were presented with the obvious objective of getting engineers to thinking in the broader terms of their citizenship and the contributions they can make to society with their background of technical information.

The machine shop practice division devoted an entire session to National Defense where "Broaching Rifling in Cannon" was discussed by Lt. Col. H. F. Safford, and "Mass Production of Aircraft Engine Parts" by H. E. Linsley.

That the activities of the Society will continue to emphasize the production of war material and take an active part in this war is indicated by the statement of James W. Parker as he took over the presidency of the Society for the coming year at the closing session of the meeting. He called upon the members of the Society to give full support to the Defense Program. "We can, if we spare no effort, outmatch our opponents in both quality and quantity. It will not be an easy task. But if the free people of the world are to win the war, we must also win the peace. In this second grave problem the mechanical engineer also has an important duty and he can make a significant contribution in this second period. The engineer approaches his problem assuming that it can be licked. He also knows that this is accomplished only by wise and persistent effort."

James W. Parker, the new president, and Donald M. Nelson at the annual dinner

Although this Society for the past 2 yr. has exerted supreme effort to support National Defense, and will continue to do so as long as the need continues, the report of the council to members of the Society indicates that the Society as a whole looks forward to the time when the defense effort will occupy a smaller part of our national economy than at present and some thought and effort are being devoted to the stimulation of research, so that industry, greatly expanded by research, may have outlet for its efforts when the defense production peak has been passed.

Although more than usual attention has been given to defense activities, workers in the Society have not forgotten that the objectives of this organization are primarily to promote the art and

science of mechanical engineering and have generously supported the activities of its 17 professional divisions, 70 local sections, 119 student branches, 16 standing, 12 special, and 26 joint committees.

Friends of Dr. D. S. Jacobus got together at a dinner in his honor occasioned by his retirement from the chairmanship of the Boiler Code Committee with which he has been connected since 1911 and chairman since 1936. He will remain a member of the Committee and chairman of the executive committee. His successor as chairman of the Boiler Code Committee

Dr. D. S. Jacobus, who retires from the chairmanship of the Boiler Code Committee and his successor, E. R. Fish

is Edwards R. Fish, chief engineer, Boiler Division, Hartford Steam Boiler Inspection and Insurance Co., who has been serving as vice chairman of the Committee. Henry B. Oatley, vice president of the Superheater Co., becomes the new vice chairman of the Committee.

Group delegates whose duty it is to recommend Society policies to Council

The one big social event of the Annual Meetings has for years been the Annual Dinner and this year the attendance reached the record of over 1200 persons. William L. Batt, past-president of the A.S.M.E., was the toastmaster and permitted no dragging moments through a 3-hr. program. The 50-yr. Members, 20 in number, were introduced; honors and awards were conferred on engineers whose talents have won them distinction; Honorary Memberships were presented to five members whose services to the Society have been notably helpful; the two principal addresses, previously mentioned, by President Hanley and Donald M. Nelson, executive director of the Supplies Priorities and Allocations Board, were followed by the President's Reception and dancing into the early hours of the new day.

On Friday, December 5, the new Council held its organization meeting at the Engineering Societies' Building with James W. Parker succeeding William A. Hanley as president. Mr. Parker is vice president in charge of engineering of The Detroit Edison Co. and comes to the presidency after many years of work in the Society's technical divisions and as

Papers on Power Topics Presented at Sixty-second A. S. M. E. Annual Meeting

Engineering Problems in Water-Steam Cycle of Central Steam Generating and Decentralized Control Systems, Parkchester, Bronx, N. Y., by S. T. Powell and John A. Dondero

Hydraulic Engineering Problems at Philadelphia Electric Company's Southwark Station, by S. Logan Kerr and Stanley Moyer

Original Features Embodied in New 160,000-kw. Oswego Steam Station, by N. R. Gibson and H. M. Cushing

The Mercury-Vapor Process, by A. R. Smith and E. B. Thompson

Mercury for the Generation of Light, Heat, and Power, by H. N. Hackett

The Flow of a Flashing Mixture of Water and Steam Through Pipes, by Max W. Benjamin and John C. Miller

Wind-Tunnel Tests on Chimneys for Riverside Station at Baltimore, by E. F. Wolf

Trends in Design of Pulverized-Coal Burners, by Henry Kreisinger and V. Z. Caracristi

Combustion of Pulverized Fuel—Mechanism and Rate of Combustion of Low-Density Fractions of Certain Bituminous Coals, by A. A. Orning

Symposium on Caustic Embrittlement:

Results of Laboratory Embrittlement Testing of Boiler Waters, by F. G. Straub

Embrittlement of Boiler Steel—Experiences With the Schroeder Detector, by T. E. Purcell and S. F. Whirl

Experience With Intercrystalline Cracking on Railroads, by R. C. Bardwell and H. M. Laudemann

Studies on the Cracking of Boiler Plate, by P. G. Bird and E. G. Johnson

Field Data From the Embrittlement Detector, by E. P. Partridge, C. E. Kaufman, and R. E. Hall

Summary, by W. C. Schroeder

Symposium on Thermal Conditions in Bearings:

Heat Conditions in Bearings—An Outline of Problems for Research, by M. D. Hersey

Effect of Diametral Clearance on the Load Capacity of a Journal Bearing, by J. T. Burwell

Notes on Heat Dissipation in Self-Contained Bearings, by G. B. Karelitz

Characteristics of Centrally Supported Journal Bearings, by E. O. Waters

* * *

Radiation Configuration Factors Using Light in Furnace Models, by Fred England and Huber O. Croft

High-Performance Fins for Heat Transfer, by W. A. Spofford and R. H. Norris

Studies of Heat Transmission Through Boiler Tubing at Pressures From 500 to 3300 P.s.i., by W. F. Davidson, P. H. Hardie, C. G. R. Humphreys, A. A. Markson, A. R. Mumford, and T. Ravese

Part I—Objectives, Apparatus, Instrumentation, Operation, and Records

Part II—(*a*) The Temperature Drop Through the Tube Wall Including the Wet Side Film; (*b*) The Shape Factor Related to Temperature Drop

Part III—The Pressure Drop Through the Tube

Part IV—The Pressure Drop Through Flow-Distributing Equipment Designed for Use in Forced-Circulation Boiler

Part V—Heat-Transfer Coefficients of Auxiliary Heat-Exchanging Equipment Used in These Investigations

A Simple Air Ejector, by J. H. Keenan and E. P. Neumann

Theory of the Ejector With Driving and Driven Fluids of Different Densities, by J. A. Goff and C. H. Coogan

Graphical Solution of Fluid Friction Problem, by E. S. Dennison

Structural-Steel Tolerances at Bonneville, by T. M. Ober

Test Characteristics of a Combined Pump-Turbine Model With Wicket Gates, by R. V. Terry and F. E. Jaski

Comparative Characteristics of Fixed- and Adjustable-Blade Axial-Flow Pumps, by J. D. Scoville

Some Problems in the Selection and Operation of Centrifugal Pumps for Oil and Gasoline Pipe Line, by Aladar Hollander

Test for Centrifugal and Propeller Pumps, by G. F. Wislicenus

Analyses of a Continuous Process by a Discontinuous Step Method, by John A. Hrones

Optimum Settings for Automatic-Controllers, by J. G. Ziegler and N. B. Nichols

SELECTED STATEMENTS OF FACTS AND OPINIONS OF AUTHORITIES MADE KNOWN AT THE A. S. M. E. MEETING

Problems in the design and selection of major equipment in Philadelphia Electric Co.'s Southwark Station centered around (a) the location of the intake and discharge passages for condenser circulating water; (b) the prevention of recirculation of warm discharge water from condensers; (c) operating head on pumps under various river-level conditions; (d) size, type, and arrangement of pumps and conduits. A comprehensive model-test program was carried out to solve certain pump, circulating-water-discharge, and condenser problems, the results of which were reported.—*Kerr and Moyer.*

* * *

The turbine-generator unit in the new Oswego Steam Station has been provided with a complete set of electronic-tube-operated supervisory instruments whose functions are:

1. The eccentricity recorder indicates and records in mils the eccentricity of the front end of the turbine shaft.
2. The vibration-amplitude recorder indicates and records in mils the transverse vibrations occurring at the four turbine-generator bearings.
3. The interference detector serves as an electric listening rod with a loudspeaker. It is of greatest service during starting and may be switched on or off at will.
4. The expansion recorder gives a continuous graphic record of the axial movement of the head end of the turbine, caused by the expansion of the shell.
5. The speed and camshaft-position recording equipment provides a continuous graphic record of the speed of the turbine during starting and shutting-down periods. When the turbo-generator is synchronized an auxiliary switch on the main circuit breaker cuts out the speed recorder and connects in the camshaft-position device which indicates the amount of valve opening, as a measure of the turbine loading.—*Gibson and Cushing.*

* * *

The new mercury boiler at the Kearny Station of the Public Service Electric and Gas Company of New Jersey began operation on May 5, 1940. It produces 20,000 kw. from the mercury turbine generator and 300,000 lb. per hr. of steam at 365 p.s.i. gage and 750 deg. F.

The porcupine tubes used for many years in mercury boilers were ingenious in design and functioned quite well, but the small passages were a potential source of plugging by foreign material and they were hard to clean and expensive to manufacture, so they were not used in the new boiler. By substituting wall tubes for the former porcupine tube surface it became possible to remove the complication of seven drums which involved equalizing difficulties and other disadvantageous features.

The solubility of iron in mercury at high temperature has been a fundamental obstacle in the development of the mercury cycle.

The present indications are that a low percentage of titanium maintained in the mercury completely stops solubility of the steel.

Looking into the future, mercury might be superposed on modern 1200 p.s.i. gage and 925 deg. F. steam and in this case 5650-kw. would still be generated per 100,000 lb. per hr. of 1200 p.s.i. gage steam.—*Smith and Thompson.*

* * *

For certain reasons, Kearny was chosen for the first application of what is now known as "treatment of boiler mercury." During the night of March 4, 1934, sufficient metallic sodium in the form of a 25 per cent sodium-mercury amalgam was added to the boiler mercury to bring the sodium concentration to 100 p.p.m. by weight of mercury. No titanium was added as yet. The immediate results were astounding, as the boiler, at the time the sodium-mercury amalgam was added, could only carry 20 per cent of full rating without overheating the boiler tubes. Immediately after the injection of the amalgam, the fire was increased to produce one-half capacity. The following day, the load was increased to full rated output of the boiler and was subsequently operated continuously for 3 mo. During this period, efforts to add titanium to the mercury were ineffectual. Various appliers were used, but to no avail, as the titanium refused to dissolve in the boiler mercury. However, the boiler appeared to operate satisfactorily with no overheating of the furnace tubes.—*Hackett.*

* * *

Model tests furnish a reliable basis for judgment in predetermining necessary stack height for the dissipation of discharge gases.

Velocities in excess of 20 m.p.h. will definitely produce a greater degree of down-draft, but these stronger winds occur with diminishing frequency. The model tests indicate that it is necessary to have a stack height of approximately 157 ft. above ground (elevation 167 ft. or 1.31 times the height of the boiler-room monitor) to reduce smoke nuisance to reasonable limits with a 20-m.p.h. wind.

The benefits from high stack velocities are found to be distinctly worth while for flue-gas dissipation. The tests indicate that a stack velocity of 60 f.p.s. is desirable at this plant.—*von Hohenleiten and Wolf.*

* * *

The principal function of pulverized coal burners is to distribute fuel and air evenly in a furnace. If the distribution is not uniform certain parts of the furnace get too much fuel and too little air, and other parts of the furnace get too much air and too little fuel. In the parts of the furnace which receive too much fuel the temperature is high and there may be a heavy deposit of slag in the furnace. There is also likely to be heavy deposits of slag on the boiler tubes and superheater where the products of combustion from the excess fuel enter the boiler. Lack of air in one part of the stream causes incomplete combustion even though high overall excess air is maintained at the furnace outlet.—*Kreisinger.*

Probably the most important result of this investigation has been a demonstration of the fact that the changes, which occur before the particle of coal ignites, exert considerable influence upon the subsequent combustion process.—*Orning.*

* * *

"The power-plant data which have been submittted to the author indicate that sodium sulphate has been effective in preventing embrittlement in the stationary power boiler. Our tests indicate that sulphate is effective in preventing failure in the laboratory at the pressures where the greatest percentage of embrittlement failures has occurred in steam boilers. This appears to indicate definite correlation between the laboratory tests and actual operation.—*Straub.*

* * *

Maintenance of the A. S. M. E. ratio of sodium sulphate to total alkalinity as sodium carbonate does not prevent embrittlement of the specimens.

A sodium-chloride to total-alkalinity ratio of 1.6 in conjunction with the A. S. M. E. ratio does not protect the specimens against failure at 420 p.s.i.

Specimen cracking is not encountered in boiler waters in which the alkalinity is controlled on the basis of the pH value.

Sodium nitrate appears to offer possibilities as an inhibitor against embrittlement.—*Purcell and Whirl.*

* * *

It was found that sodium sulphate does not prevent or even delay embrittlement cracking; that waste sulphite liquor will prevent cracking of detector specimens on many boiler waters, failing in but few cases; and that sodium nitrate has essentially eliminated cracking of detector specimens on the entire system of The Chesapeake & Ohio Railway.—*Bardwell and Landemann.*

* * *

Tests show that, of the inorganic substances used to inhibit cracking, sodium nitrate is one of the best when combined with organic matter. With a given feedwater, it was found that ever-increasing amounts of inhibitors are required as the number of concentrations increase.—*Bird and Johnson.*

* * *

Perhaps the answer in any particular case will lie in the use of tannin; on the other hand, nitrate may demonstrate its superiority, or the reduction of the sodium-hydroxide content of the boiler water substantially to zero by maintaining alkalinity with phosphate may prove satisfactory and desirable.—*Partridge, Kaufman and Hall.*

* * *

The conclusion is reached that a new epoch in bearing design is approaching in which the assumption of constant viscosity must give place to a study of heat conditions. This situation is intensified by the increasing loads and speeds to be dealt with in meeting national-defense requirements.—*Hersey.*

D. Robert Yarnall, humanitarian, engineer, and leader in the engineering profession whose distinguished public services have earned for him the Hoover Medal for 1941

member of Council. He will have with him as new members of Council four vice presidents: Clark F. Freeman of Providence, R. I.; Clair B. Peck, New York City; W. H. Winterrowd of Eddystone, Pa. (Just prior to the Annual Meeting, Mr. Winterrowd suffered injuries in an automobile accident. These, however, were not considered serious, although preventing his attendance at the meeting, but a turn for the worse caused his death the following week); and W. R. Woolrich of Austin, Tex.; and three new managers: William G. Christy of Jersey City, N. J.; Herbert L. Eggleston of Los Angeles, Calif.; and Thomas S. McEwan of Chicago, Ill.

Technical sessions of the meeting were well attended and those of interest to power plant engineers (see partial program herewith) were filled with valuable papers and discussions. In all nearly 100 technical papers were presented. Only one fuels session was held, inasmuch as most of the papers prepared during the latter part of the year had been presented at the meeting in Easton, Pa. This was devoted to pulverized coal burners and combustion. Four power sessions were necessary to present the available papers, with another session on power-hydraulics, the subjects being closely related. At these sessions features of modern plant design were discussed as exemplified in such plants as Parkchester, Southwark Station, Oswego Steam Station, and features of the most recent mercury vapor plants. Boiler feedwater studies have been energetically carried on during the past year and the findings were presented in a symposium on caustic embrittlement. Two entire sessions were devoted to studies of heat transmission through boiler tubing at pressures from 500 to 3300 lb. per sq. in. which have been carried on by the research department of Consolidated Edison.

Space in this report does not permit giving abstracts of these papers, many of the outstanding statements of authors, however, are briefed in the accompanying quotations which have been selected to give an idea of the trend of developments.

Recipients of Honors and Awards

Robert Yarnall—Hoover Medal, for outstanding humanitarian activities constituting distinguished public service.

Paul E. Holden—Gantt Medal, for outstanding achievement in the application of management principles in industry and business.

John C. Garand—Holley Medal, for his distinct contribution to our National Defense.

Theodor von Karman—A.S.M.E. Medal, for his distinguished leadership in the fields of aerodynamics and aircraft design.

Richard Vynne Southwell—Worcester Reed Warner Medal, for his many distinguished services to engineering and science through papers and publications in many fields.

Roger V. Terry—Melville Medal, for his paper, "Development of the Automatic Adjustable-Blade Type Propeller Turbine."

R. Hosmer Norris—Pi Tau Sigma Medal, for outstanding achievement in mechanical engineering, particularly in the heat transfer field.

John T. Rettaliata—Junior Award, for his paper, "The Combustion Gas Turbine."

Honorary Memberships

Clarence Decatur Howe, Minister of Munitions and Supplies for Canada.

Clarence Macon Wesson, Major General of the United States Army and Chief or Ordnance.

Samuel Murray Robinson, Rear Admiral of the United States Navy and Chief of Bureau of Ships.

Aurel Stodola, Professor of Mechanical Engineering at the Swiss Technical University in Zurich.

Leon Pratt Alford, Fellow and Past Vice-President of the A.S.M.E.

J. W. Parker, E. G. Bailey, Harvey N. Davis and Clarence Davies at the council dinner

REFRIGERATING ENGINEER

(Continued from Page 79)

machine consisting of two horizontal cylinders spaced widely apart. Both cylinders are connected by way of cross heads and crank disks to a large crank shaft. At the center of the shaft is a synchronous motor, which drives the compressor. In several ways the new compressor is the reverse of the old. The crank shaft drives, instead of being driven; the compressor is horizontal instead of vertical; and the cylinders doing the compressing are not only outside the driving motor, but are also cross-compounded like the steam engine. One cylinder discharges its gas to a cylindrical gas intercooler at medium pressure, and the other cylinder draws its gas from the intercooler.

From the compressor you trace the discharge line to a horizontal vessel which you determine to be a horizontal multi-pass shell and tube condenser. From the condenser the liquid flows to the horizontal liquid receiver, which is much like the one at the Wholesome. But the next vessel, a well insulated one, you fail to recognize. It is just beyond a float regulator.

Frosty explains it. "That vessel is the evaporator of a two-stage system. Through that float regulator the liquid ammonia enters the vessel. At the lower pressure, a part of the liquid evaporates and cools the rest. The gas evolved goes back through that line to the compressor, while the cooled liquid keeps on to the cooling room coils. There float regulators admit it to the evaporators, instead of expansion valves."

"That's a lot different from the systems at the Wholesome," you comment, then ask, "Which system is the best?"

"Both are good ones," Frosty says. "And there are more good ones than just these two. Any one system has the edge on another in one or more ways, and in some ways it hasn't. The system in use at any plant is usually designed to meet a certain set of requirements."

(To be concluded)

War News From the Industrial Front

SPAB's Policy on Power Projects

IN LINE with the policy laid down earlier on construction, the SPAB recently announced a broad policy covering the building of public and private power projects. The policy directs that every effort be made to aid in the completion of projects now substantially under way, but that aid be withheld from new projects unless they can be shown to be essential to national defense or to the public health and safety.

Both public and private power projects must be treated alike, and the mere possession of a substantial inventory should not allow one group to undertake a project for which the other is denied priority assistance.

During the emergency, neither public nor private power bodies may start projects which would duplicate facilities of the other. Private power companies may not take advantage of inventories they now have to preempt an area under development by REA.

All proposed extensions, whether by public or private power companies, and whether involving inventories on hand or materials to be acquired, must be submitted to OPM for approval, disapproval, or modification. This does not, however, apply to low tension drop lines from existing systems.

Utility Expansion Order

PUBLIC UTILITIES are forbidden to undertake any substantial expansion of property or equipment without express permission from O. P. M. by Amendment No. 3 (to Preference Rating Order P-46) issued December 11 by the Division to Priorities.

The order as amended applies to all producers engaged in supplying electric power, gas, water, public sanitation services, or central steam heating, regardless of whether or not they have applied for priority assistance by executing an acceptance of the order. It applies to publicly owned as well as private utility companies, and will cover R. E. A. cooperatives.

This is in line with the policy adopted earlier (see above) by S. P. A. B. of disapproving projects for new or expanded utilities unless they are essential. However, projects already under way and at least 40 per cent complete as of December 5 may be finished if the utility has supplies on hand for the purpose, or is granted priority assistance to obtain them.

With that one exception, utilities may not without permission withdraw materials even from their own stores or inventories for expansion projects costing more than $1500 in the case of underground connections, or, more than $500 in other cases.

Preference Rating Order P-46 as originally issued on September 17, 1941, permitted specified utilities and their suppliers, after executing an acceptance of the order, to use an A-10 rating to obtain maintenance and repair materials and operating supplies. It contained inventory and other restrictions which were construed not to apply to utilities which did not execute the acceptance or apply for priority assistance. With today's amendments, the order covers all utilities of the types specified, without exception.

Utilities will continue to receive priority assistance when necessary to obtain operating supplies and materials needed for maintenance and repair, with certain restrictions based on use during 1940 but all utilities are required to maintain a continuing inventory of material included in stores accounts.

Mobile Power Plants

TWO MOBILE electric generating plants with a capacity of 10,000-kw. each are being built for use along the Pacific and Atlantic Coasts in wartime emergencies such as the bombing or sabotaging of regular power houses. When not in actual service they will be kept in readiness at a central point.

These traveling electric plants are projects of the United States Navy and are being built by the General Electric Co. They will be operated by steam and will have boilers, turbine generators and other equipment comparable to the installations in the very newest central stations. Each will be housed in two specially-constructed railroad cars. It is estimated that they will be hooked up and delivering power within 24 hr. after reaching the scene of an emergency.

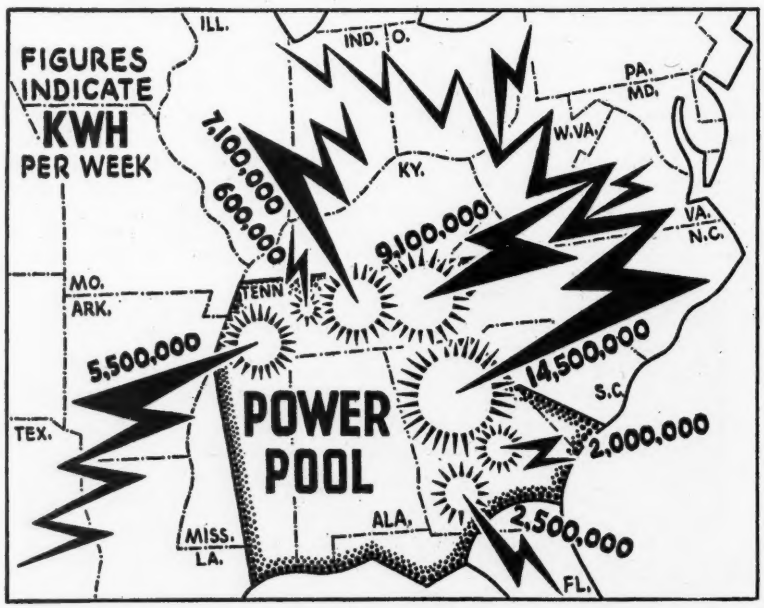
Tacoma Bridge to Be Rescued

APPROXIMATELY 3500 t. of scrap steel will be salvaged and eventually routed into the Nation's armament program. The "rescue" of the steel, which became scrap as a result of the Tacoma Narrows Bridge collapse in November, 1940, was accomplished through the joint efforts of several branches of O.P.M. cooperating with the State of Washington Toll Bridge Authority. The rescue was arranged after the O.P.M. was notified of a decision to drop the damaged bridge structure and cables into Puget Sound, a decision which had been reached, it was said at that time, because the cost of reclamation exceeded the immediate scrap value of the metal.

Chromium Earmarked

ON NOVEMBER 27 the Priorities Division of O.P.M. took under its charge all deliveries of chromium, and earmarked for defense all high chromium content alloy steel produced after December 1. Within the week the Division extended the effective periods of orders dealing with calcium-silicon; cutting tools and materials for them; pig iron, steel, steel warehouses, and special kinds of iron and steel. At the same time, control of titanium pigments was postponed from December 1 to January 1.

(Continued on Page 110)



Power for defense . . . Surplus electric power from 13 States, forming almost a solid block from Pennsylvania to Florida, and from Illinois to Texas, is flowing into the Southeast, where a power shortage has existed because of drouth and heavy defense loads. The lightning bolts in the drawing are thickened as they move toward the area to indicate that power is picked up all along the line; the figures show the kilowatt-hours of power each line brings in each week. The pooling arrangement was carried out by an order of OPM.

The PRACTICAL ENGINEER *and* ELECTRICIAN

RICHARD H. MORRIS, EDITOR

NO GLAMOUR, NO GLABER —JUST WAR AND DESPAIR

Being neither glamorous like A.W.K., the ex-M.C., nor, glabrous like R.E.T., the ex-ex-M.C.; with neither the shrinking violet spark of genius of Pulverizer Pete, nor, the lubricous placidity of Atomizer John; without faith in the claims of Mr. Ain't's boastful antagonists that engineering will sway women and mathematics will influence horses; I stand facing a glaring row of 24 blank pages each month, the row stretching far into the future.

Now 24 pp. means an awful lot of words in any language and I am kept tottering on the brink of the Slough of Despair only by an abiding faith in the Alger Theory of Hard Work; the providing hand which Providence is supposed to extend to the Working Stiff; and (the only one of the three that offers real possibilities) the continued interest and support of hundreds of engineers who have made the P.E. & E. what it is.

Unfortunately it seems my fate to take over this section at trying times in world affairs. In 1939 three separate and distinct wars had just started. In the ensuing 2 yr. the situation has improved quantitatively in that there is now but one war, but, it has deteriorated qualitatively, in that this one war circles the globe and involves our own country.

This war must be won not only for ourselves, but to maintain intact that firm foundation erected by our forefathers, and left in trust, as a guarantee that each new generation be free to work out its own salvation from firm footing.

Many, including the majority that saw service in the last war, are destined to play a minor role, without cheers and music. But let none doubt the importance of that role. Never before has manpower by itself been less important and equipment more important. Fundamentally this is a war of production — and in production not even modern machine tools play a more important part than power.

Gentlemen—We drink to Victory! Let no engineer shirk his duty, refuse to extend a helping hand, nor begrudge the cheers and glory to men who are risking all, with no protection but the equipment you supply.

Richard H. Morris.

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A Section of Power Plant Engineering Devoted to PLANT OPERATION AND MAINTENANCE

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THE ENGINEERS' PRIMER. I

In which we look at this power problem as a whole to find out "what it's all about." Mac says, "Every successful engineer knows he is in business to manufacture heat and power. The plant and machinery are incidental—simply a help in polishing up the versatile B.t.u. so it sells for a good price—and of course show a nice profit."

By Richard H. Morris

"Good Morning, Mac, better let me give you a lift as far as the plant, you don't look so good this morning."

"Don't feel so good either. Getting to the point where I need my sleep, Andy, and those confounded tomcats in your back yard kept me awake most of last night."

"They must be pretty bad; I sleep right on through it all, but the neighbors are complaining. Guess I'll have to get rid of Tom 'cause he sure does like his singing and he has too many friends."

"I started to get up to throw shoes like they do in the funny papers, but it was cold, I need my shoes and after all he has good reason to like music."

"What do you mean—he's got good reason?"

"Well, he's full of fiddle strings, isn't he?"

"Wish I could get the neighbors to appreciate your humor, Mac."

"Glad you appreciate the joke anyway. You know I was so pleased with my cleverness last night that I lay awake in a mellow mood and thought quite a bit. After all, cats are more clever than most engineers."

"More clever than most engineers?"

"Surely. They know why God filled them with fiddle strings and make use of them. Most engineers have a plant full of fiddle strings and live their whole life without ever knowing what it's for."

"Don't be foolish."

The farmer changes his hog for money to get the other things he wants

"I'm not foolish and if you think I am, answer this: just what part do you play in the plant full of fiddle strings you have—what's it all for? Why do you lord it over all the place like a top-kick over a company of recruits?"

"Why, my job is to see that the men work, that the boilers are clean, that the engines are kept in good shape, that coal and supplies are on hand . . . ."

Which Comes First?

"Fiddlesticks, to keep up the allusion to cats, mere fiddlesticks incidental to the music. Your function, sole function, is to run those confounded shafts, belts and pulleys out in the shop, put light where the men can see what they do, to put steam at the hammers, to put heat in the buildings and at the ovens, and to put compressed air where it needs to be used."

"But Mac, those things come only from a well run power plant—they are incidental to good plant operation."

"No, they are not! Good plant operation is for, and incidental to, them to make the services reliable and economical. Just as I said before, so many engineers fail to realize what it's all about. They set themselves up as tin gods in a little kingdom by themselves and let the world revolve around them, an inferiority complex—protective shell brought about by the conviction that the power plant is a necessary evil! That is a chestnut which comes down to us from the days when James Watt showed the world that treadmills and horses were but one form, and a mighty poor form, of power. The power plant is not a necessary evil but a business asset although, unfortunately, too few engineers put that across."

"But where do we come in the business picture?"

"As chief engineer you are managing a manufacturing plant, a highly specialized and important industrial monopoly. You take coal, cheap, black, dirty coal that costs $4.50 a ton. You take that coal and extract the B.t.u.'s which costs 18 cents a million. You polish and shine them up, 'til they are worth about $4.50 a million. That's about 2500 per cent increase in value added by manufacture. Don't you think your boss, the Merry Miller, would be surprised if you walked over to his office and told him that you had a process of polishing up B.t.u.'s that increased their value 2500 per cent?"

"Not knowing what a B.t.u. was he probably would, but you know, Andy, our steam only costs us about 60 cents a thousand pounds which would bring the value down to something less than that a million B.t.u. That's only an increase of about 300 per cent."

"Only 300 per cent! Surely the business world would go broke soon if they could only make 300 per cent. That, however, is not its value, it's what the B.t.u.'s cost you. Their value is what they would cost if you went out and bought them. The only other B.t.u. available are from the power lines of the public service company at 1.5 cents per kw-hr. of just about 3414 B.t.u."

"That's true to a certain extent, but we could go back to stoves, kerosene lamps and hand forging and buy only some power for motors."

"Yes, and go out of business when your salesmen went up against the lower production costs of your competitors. You can buy electric power about as cheap as you can make it, but only a few companies are situated so that they can buy the other power plant services. There is where your monopoly comes in—but you must make the grade and supply these services at least as cheap as the company's competitors secure theirs."

Competition Sets the Pace

"Competition is pretty stiff, all right."

"Stiffer than you think, perhaps, and getting stiffer. It's not confined to your sales department, either. I saw the power company salesman coming out of Miller's office the other day."

"Yes, I've been worried about him lately—been working Sundays again to keep the plant in extra good shape and wondering if I made a mistake in suggesting that any new load be carried on purchased a. c. power."

"Well, don't bother worrying. I know him. Johnson's his name; nice chap, but isn't getting to first base with Miller."

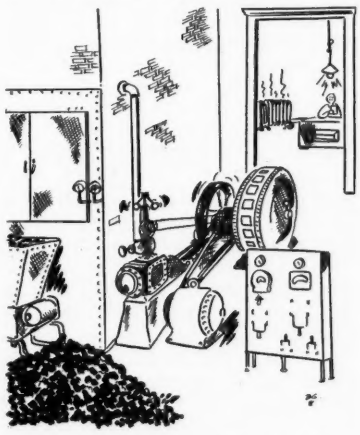
"Why?"

"I suspect because he doesn't know about the possible new load and is working on the old. Miller is kind of set in his ways. You, or rather your plant (because you were not here then) has

been running along about the same since the war, but you have been trimming a few dollars off here and there each year so it seems you are getting better and better. The plant is old and all off the books so that coal and labor are about the only expense now while changing to purchased power would mean a considerable investment for conversion from d.c. to a.c."

"Well, we have been pretty tight lately with few losses and looking back at the war years' records we are running pretty cheap now."

"Surely, but since then central stations have cut their fuel costs in half, many of them are making a kilowatt-hour on less than a pound of coal. Some



Coal, or other fuel, is the power plant hog—the engineer changes it into heat to get the things he wants

industrial plants are making a kilwatt hour on 5000 B.t.u. or almost 70 per cent thermal efficiency, which is something to think about. A streamlined 1.5 cent kw-hr. on 0.9 mills worth of your coal—only a good many of them are not burning $4.50 coal but $2.50, 10,000 B.t.u. coal so they make that kilowatt hour for 0.00625 cents worth of coal or 16 kw-hr. for a cent. Pretty good, eh? What do you do?"

"Well, we evaporate about 6.5 lb. and the water rate is about 33. About 5 lb. of coal per horsepower. But, of course, we use a good bit of the exhaust most of the time. I figure we could cut the coal in half if we made no power."

"Five pounds, say a cent's worth of coal per horsepower, or 1½ cents worth per kw-hr. as a maximum—half that as a minimum. That isn't so bad considering the exhaust steam is used but the 'most of the time' does wipe out some of the credit."

"That's true. Then since the river got so bad we have to use city water. It's a small item, but it mounts up and it scales pretty bad too. Those fellows you speak of have new plants though, with all these new gadgets."

"Sure they do and why?"

"I don't know; if I did I'd get some too!"

"Because they are in business. Those fellows like a power plant because of what it will do, not because of what it is. They sell heat and power to the rest of the plant. The shop men don't care what form it's in, all they want is light, heat in a digester or vat, power to turn a grinder. Right now steam and electricity are good carrying mediums. Tomorrow it may be something else. Steam, electricity and the equipment that makes them is of no use in itself. It's of use only as it will give heat, light and turn machines."

"You mean it's no good?"

"Not by itself. It's the currency of industry. The gold, silver and credit of our business. In the old days a man raised, say, a hog. Now to live he needed not only meat but flour, sugar, perhaps a gun, a little powder and a bit of rum. He would take the hog to market and begin to trade—maybe he could make the right kind of trade and maybe he couldn't. Then money became more plentiful. Today a farmer raises a hog. He takes him to town and sells him for cash. With the cash he buys the other things he needs, easily, handily in the quantities he wants."

"Where does the hog get in the power plant?"

"The coal you use is the power plant hog, even though you as a Yankee trader don't raise it yourself. Coal has always been the basic fuel of this country. Years ago it was used in small stoves or furnaces around the plant where needed. Small boilers and engines would be scattered around where power was needed without worrying about water power. Then someone discovered that steam carried heat very nicely to exactly where it was needed. It was easy to control and furthermore all the coal could be burned in one large furnace much more effectively than in many small ones. Electric lights were introduced. Electric motors were invented and people began to see that electricity carried power just as well as steam carried heat."

Grandpa Was Good

"That's all ancient history."

"I know, but today you need the heat and power just as they did 75 yr. ago but you know how to supply that need better than your grandfather did and the shop men know how to use more of it."

"But they say grandfather was a good engineer."

"I dare say he was—so was Watt. Corliss and a thousand others whose native ingenuity laid the foundation of the industry. In its day the stage coach was good transportation, but it could hardly compete with a streamliner today."

"Still we got to run our plant just as they did in the old days."

"Sure, you do. But you don't have to spend all your time polishing and petting old Betsy and promising her a new set of store teeth if she'll run another 30 yr. Threaten her with a spanner and say "You old brute, another cylinder head and out you go on the junk pile" and then think up a good excuse to put her there. And in the boiler room not—'Pretty good, the boiler inspector only knocked off 10 lb. last time', but 'Jim Perry gets three times as much steam out of a boiler room half as big. Have to get rid of you as soon as the junk man comes around.'"

"To my way of thinking the junk man and Jim Perry make a good team. They tell me he throws out enough stuff to supply a good sized second hand dealer. Who couldn't have a good plant with the Boss handing out money on a silver platter? If ever a fellow was born with a silver spoon in his mouth Jim Perry was."

The Silver Spoon Is Out

"He does keep changing, but don't fool yourself—every piece of equipment that goes in or out of his place will pay, or has paid, for itself in one way or another. But there was no silver spoon. Jim got everything the hard way and, believe me, he's earned it."

"Seems to me he has a pretty soft job. I've been over to his plant two or three times. He's been cordial enough and though he doesn't talk much you can see he's swelled up like a poisoned pup about his plant. And talk about polishing and pampering. I'll bet he personally tucks the whole plant in bed before he goes home."

"He almost does at that, but he's a born engineer, seems to do the right thing instinctively, loves machinery and still likes to turn wheels and push buttons although when he finds a new wheel or button that will do the job better or cheaper he has no compunction about junking the old."

"How about the old two by four antique of an engine he has in a show case to say nothing of that sea-going cap he affects?"

"Neither of them are affectations, but a bit of sentimentalism all tied up with the war, his company, what he is and his plant although with his other work that's not much more than a hobby now—a kind of a labor of love, his first and as far as I know his only serious one. It's odd you've never heard his story, but come to think of it I suppose very few have."

"Well, he doesn't talk much and lives way over on the other side of town, so I don't see him often. Frankly, I've never cared for him, but he did tell me once that he knew you rather well."

"Yes, as a matter of fact you might say we are close friends, although I don't often see him since I moved over to your side of town. Through an odd combination of circumstances we were thrown together quite a bit, long before you came here. We lived in the same neighborhood, did a bit of carousing and found it convenient to work out our problems together. As a matter of fact we still do but there's no time to tell you the story now. My car is still out of commission, come past and pick me up tonight and I'll tell you the story on the way home. I think you'll be interested and I'll save both bus fare and a half hour's time."

(Next Month—A Word About the Heat Balance—Its Value and Limitations)

SHORTS

External corrosion of pipe and other metal surfaces can be prevented by first thoroughly wire brushing the surface and then covering with a corrosive resistant paint.

* * *

Charging a refrigerating system through the compressor is a dangerous practice. Large slugs of liquid may crack a cylinder or head even though the machine is equipped with safety heads. The refrigerant should be introduced into the system through the receiver or through the evaporating coils.

* * *

Where bearings are submerged in water as in some pumps, tail shaft bearings for ships and lower bearings of hydraulic turbines, rubber and plastic bearings have been used to advantage. Non-metallic bearings, made of fine fabric and synthetic resenoids moulded under pressure have proven particularly successful in replacing lignum vitae bearings in the latter service.

* * *

Tests show that the deposits in the combustion chamber and exhaust passages of Diesel engines increase from 200 to 500 per cent when the engine rating is reduced from maximum to below half load. Under comparable conditions deposits in engines operating at high altitudes are less than when operating at sea level.

* * *

Ball bearings and other steel products can be surface hardened without affecting the internal structure by passing them through a high intensity, high frequency magnetic field. The depth of hardening and the structure can be controlled by varying the frequency and power input. High frequency currents have also been successfully applied to drying of glues in laminated wood.

* * *

Freon is miscible in oil, that is, it dissolves the oil and carries it along. If liquid or saturated refrigerant returns through the suction piping, the warmer temperature in the crankcase evaporates the Freon from the mixture. The residue has a tendency to cause foaming in the crankcase which promotes pumping of oil by the compressor. This can be prevented at least to an extent by the use of an effective oil separator in the suction line.

* * *

In a typical well designed distillery 33 per cent of the steam is used in the evaporators, 22 per cent in the distillery, 17 per cent in the dryers, 16 per cent in the power plant and for heating, 9 per cent in the cookers and 3 per cent in the stills.

FOR THE PLANT ELECTRICIAN

Calculating the Right Size of Wire

By Eugene George Key

Do you select wire size from tables solely on the basis of the current carrying capacity? That's simple and easy, of course, but it's only half of the story as you will see from this article. Of course, the wire must have sufficient area not to overheat, but it should also be large enough to keep the voltage drop to less than 2 or 3 per cent. A wire entirely satisfactory for a short run may well be far too small for a long run—result—low lamp and motor efficiency and high power bills for no good purpose.

IN TIMES PAST, wiremen have been too prone to accept tables showing the allowable current-carrying capacities of wires and to use them regardless of the requirements of a particular installation. Although there is still a tendency to stick to that practice, efforts are being made to educate or even force the use of larger wires when good wiring practice demands.

As an example of what can happen, in one installation an electrician was called to determine the cause of an exorbitant electric bill. The electrician found that the voltage across the lamps was so low in some parts of the building that two lamps were required to give the light that should have been furnished by one. He pulled out all the wires in the building and installed larger sizes. The user reported an appreciable reduction in his electric bill as a result.

Suppose that a branch circuit feeds a 1000 w. load. At the main switchbox a voltage of 115 is available. The branch circuit being in the third floor front of the building, is about 200 ft. from the main box. Regardless of the length of the run, the voltage at the load should not be less than 98 per cent of the voltage at the meter. This means that the voltage at the load, with 115 v. at the meter, should be not less than 112.7. Practically, if the voltage is very much lower than that, the amount of light per volt drops off so rapidly that at 103 v. a 115 v. lamp will give only about two-thirds of the light that it would if operating at its full rated voltage.

Suppose that in a given installation, 112.7 v. is to be obtained at the load when 115 v. is available at the meter. Then the current required for the 1000 w. load will be approximately 9 amp. Since the allowable current capacity of No. 14 wire is 15 amp., some wiremen would assume that No. 14 would be large enough for the installation.

Number 14 wire has a resistance of 2.575 ohms per 1000 ft. In the 200 ft. run assumed, 400 ft. of wire is required for the job (two wires, each 200 ft. long). The run will have a resistance of 1.03 ohms giving a drop of about 9.3 v. at the load of 105.7 v. This is obviously too low. The way to calculate the correct size of wire for the desired conditions is as follows:

(1) Determine the voltage at the meter by measurement or by inquiring from the power company. For the purposes of this illustration, this is assumed to be 115 v.

(2) Good practice demands not more than a 2 per cent voltage drop from meter to load but motor installations can stand a 3 per cent drop. The voltage at the load in this illustration should, as already shown, be 112.7 v. The desirable load voltage should be determined as follows:

(3) Calculate the current required by the load at this voltage. In our illustration, this current is:

$$I = W/E = 1000/112.7 = 9 \text{ amp. (nearly)}$$

where: I is the current in amperes, W is the total power in watts supplied by the run and E is the load voltage.

(4) Calculate the maximum resistance permissible for the 2 or 3 per cent drop with the current found in (3). In our example, this resistance is:

$$r = Ed/I = 2.3/9 = 0.256 \text{ ohms.}$$

where: r is the allowable resistance; Ed is the voltage drop (2 per cent of 115); and I is the load current in amperes.

(5) Estimate the length of the individual run from the meter to the last outlet supplied by the run. In this illustration, the length is 200 ft., making 400 ft. of wire.

(6) Calculate the size of wire that will give the desired voltage drop or less (never more). There are two ways that this can be done:

(a) Some tables give resistances of wire in ohms per 1000 ft. In our illustration, the resistance per 1000 ft. would be:

$$R = 1000\ r/l = (1000 \times 0.0256)/400 = 0.640 \text{ ohms}$$

where: R is the resistance in ohms per 1000 ft.; r is the total maximum desired resistance in the run; and l is the total length of the wire. The table shows that No. 8 wire has a resistance of exactly 0.640 ohms per 1000 ft. and is the size to use.

(b) Copper has a resistance of 10.4 ohms (nearly) per circular mil foot. Under the conditions desired in this example, the resistance should be as found in (4) so that:

$$A = pl/r = (10.4 \times 400)/0.256 = 16{,}250 \text{ c.m.}$$

where: l is the total length of the run in feet; p is the resistance in ohms of a circular mil foot of the wire (10.4 for copper); r is the total desired resistance in the run; and A is the area of the conductor in circular mils, abbreviated c.m.). The wire size table shows that the nearest larger wire is No. 8 which has an area of 16,510 c.m. This result checks with the method in part (a).

Where the same table gives values for both of these quantities, the safest way is to use both methods of calculating the size of wire and check one against the other.

Only in housewiring is a single circuit carried all the way from the main switchbox as in the illustration given here. In industrial practice, large wire is generally run from the main switchboard to the branch panel from which all branch circuits in a given area are fed. The 2 per cent allowable drop should still be calculated from the meter (or main switchboard, since the meter is usually located on or near the main switchboard).

This kind of installation can be calculated in any number of ways depending on the wiring practices of the company whose property is being wired. The final test of the job is that the allowable voltage drop must not exceed 2 per cent on lighting or 3 per cent on motor circuits if satisfactory performance is to be obtained. The following suggestions may help:

(1) Calculate every branch circuit from the meter by the method already explained. This is the size that should be used from the branch panel to the load. All sizes in circular mil areas should then be added and the cable feeding the branch panel from the main board should have an area equal to the sum of the areas of all the wires feeding the branch circuits plus an allowance for future expansion.

Suppose a branch panel has positions for six circuits, four of which are to be in use. Assume two of these circuits to be wired with No. 10 wire and two with No. 14. Since No. 10 has an area of 10,380 c.m. and No. 14 has an area of 4,107 c.m., the total area in use is 28,974 c.m.

Three methods are open for estimating the allowance for the future use of the two unused positions. The wireman may think that allowing for two No. 14 wires is sufficient. He may be very conservative and allow for two No. 10 wires. The third alternative is to allow for a 14 and a 10. The size of cable for these three methods would be:

(a) Two No. 14 wires:
Size = 28,974 + (2) (4,107) = 37,188 c.m.

No. 4 conductor has an area of 41,740 c.m. and No. 5 has an area of 33,100 c.m. Since 37,188 c.m. is a minimum requirement, No. 4 should be used from the meter to the branch panel.

(b) Two No. 10 wires:
Size = 28,974 + (2) (10,380) = 49,734 c.m.

Size No. 3, with an area of 52,640 c.m. would be used.

(c) One No. 14 and one No. 10:
Size = 28,974 + 10,380 + 4,107 = 43,461 c.m.

This method would also require No. 3 wire.

Other methods for estimating future requirements may be used, but these are suggestions. Where the branch panel feeds an area where lights or power are used intermittently, smaller sizes may be used than those here indicated, as the maximum load on the panel circuit is seldom switched on at any one time.

(2) Sometimes the company practice is to use one size of wire for all branch circuits, say, No. 14. If so, the voltage drop should again be calculated from the meter to the last outlet and the resistance should then be found for No. 14 wire from the branch panel to the load. The size necessary for a single run from the meter to the panel would then be larger than that calculated if the branch run used were larger than No. 14.

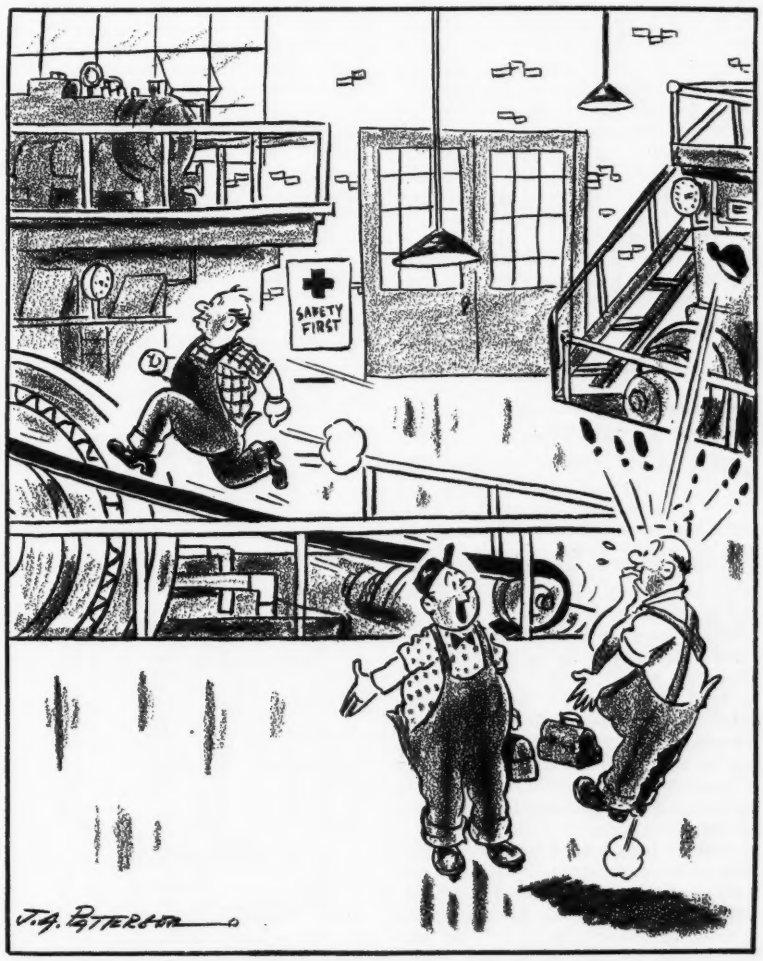
If No. 10 would be correct from meter to load and No. 14 actually is used from branch panel to load, a size as large as No. 6 may be necessary from the meter to the panel for the allowable voltage drop on that one circuit alone. The size of the cable used to supply the panel then would be the sum of the sizes of the wires necessary if every circuit were run individually with the larger size to the panel and No. 14 to the load. Possible future additions should be estimated and added to the feed-cable size as in Case 1.

(3) Somewhere between Case 1 and 2 may be an economic balance. The larger the wire used from branch panel to load, the smaller will be the cable from meter to panel. The wireman can best decide what combination to use. The only method possible for determining the most economical combination, neglecting company rules unless flexible enough to allow changes, is by trial and error, finding the sizes possible under various combinations of methods and then consulting a price catalog to determine the cheapest run.

(4) If the panel is fed by a 3-wire Edison system, the feeder wires from the meter can be very much smaller than in any of the three previous cases.*

(5) If a 3-phase system is being planned, a simple method would be to determine the current to be carried by each phase. Then use half of the voltage drop allowable and apply the method to only one conductor. The size of wire to be used for each phase would then be the size found for one phase.

*Reference should be made to the article, "Calculations on the Three-Wire System," pages 63-65, June, 1940, POWER PLANT ENGINEERING. Although the formulas given in that article are for finding voltages and currents, they may be used for calculating the resistance of the wires as well. From the resistances thus calculated, the size of wire may be found as explained in this article.



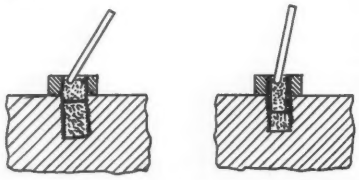
"That's how he spends his lunch hour—he's trying to reduce."

HINTS AND KINKS

Speedy Stud Removal

By P. C. Ziemke

WHERE CAP bolts, studs and key heads break off, much valuable time may be lost in removing them. Where welding equipment is at hand, however, this job is greatly simplified. Where the stud is broken off flush with the surface one takes a nut the same size or smaller than the stud and places it around the broken section.



Methods of removing broken studs by the use of welding. Application of heat helps break the bond

Then by using a small size weld rod, preferably heavily coated, the nut is welded to the exposed portion of the stud. When the work cools a few hammer blows and application of a snug fitting wrench will bring out the stud.

Where the stud has broken down into the hole one places a brass or copper ferrule of snug fitting size in the hole. This is then cut off flush with the machine surface. Next put the nut in position as in the previous operation and fill the cavity with welded material and proceed to back it out.

The secret lies in the fact that the application of heat cracks the rust and compresses it, thereby causing it to lose its grip.

Trouble Free Gage Connections

By N. T. Pof·

BECAUSE all gages are provided with ¼ in. pipe threads and therefore call for ¼ in. pipe, many power plant operators make the mistake to provide an opening in the steam, oil, gas, air or water main for ¼ in. pipe size. This is wrong for two reasons. The first and the main reason is that a ¼ in. nipple does not have the strength to stand the abuses that may come in the following 10 or 20 yr. of its life. It may get knocked about, careless men may hang objects on it, the pipe line may sag, in disconnecting the union too much force may be applied in one direction, etc., and a breakdown of a ¼ in. outlet on a main pipe line may mean the shutdown of the whole plant.

Outlets for gages should be not less than ½ in. pipe size and ¾ in. is still better. A short nipple should be followed by a valve of the same size, then a reducing bushing to ¼ in. size followed with a short nipple and finally by a ¼ in. union. This gives strength and durability. If the occasion requires to disconnect the union you don't have to say a prayer before you apply the wrench to the union.

The other reason why a ¼ in. outlet should be avoided is that the stoppages usually occur here and in order to unstop them the main line has to be shut down. But if a larger outlet is provided the stoppage will most likely occur beyond this point, so that by shutting the valve, that gage line can be cleared without interrupting the main line.

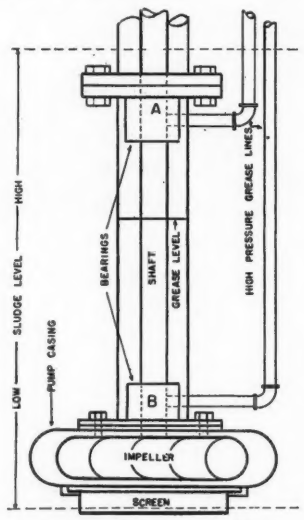
Safe Grinding Wheels

GRINDING WHEELS should: run true and without vibration; never run faster than the speed for which made; should always be fitted with protecting hoods; and have the drive belt adequately guarded. Before installing a new wheel, it should be given a test to see if it is sound. This test is made by suspending the wheel free in air and tapping it with a wooden screw driver handle. If the wheel is sound it will give forth a clear, metallic ring when so tapped. Bearings should be kept oiled, as a heated arbor may cause the wheel to burst. The tool rest should be set a little above the center of, and always close to the wheel—and, when operating emery wheels, do not forget eye protectors.

Sewage Pump Bearings

By John A. Grant

WE HAVE a twin set of sewer pumps and have had trouble with sewage, water and grit working up around the impeller into bearing B. This wears the bearing and as a result cuts into the impeller shaft at bearing A. The shaft housing is a large pipe made in two sections with flanges on each end.



Grease packing eliminated trouble on this sewage pump

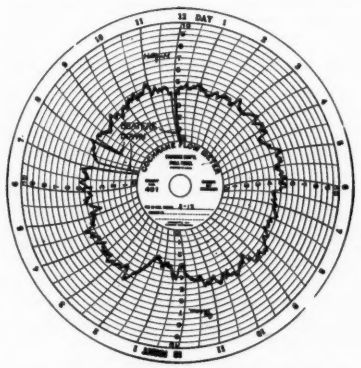
The last time one pump was taken out it had to have new bearings and the shaft, impeller and housing had to be dressed down. When the pump was reassembled we put high-pressure grease lines on instead of oil. We filled the lower shaft housing about two-thirds full of gun grease. So far we have not been bothered with our old trouble.

However, enough grease by weight must be placed in housing to offset the sludge pressure coming up from the impeller side. We always keep plenty of grease in bearing B through the high-pressure line. A clearance should be left between the grease line, in shaft housing, and bearing A.

Meter Records Improve Operation

THIS CHART shows the record made by a Cochrane flow meter measuring steam to the prime mover that drives the machines in the beater room of a paper mill.

This meter has been in service for several years. When first installed it was watched to determine the steam consumption and to give the plant superintendent a record of the number of shutdowns in the beater room.



Flow meter chart from a paper mill used to check on operation

The meter showed also the tendency of the operators to turn the beaters down so closely as to increase the steam consumption very rapidly. After the installation of the meter, the operators were better able to control the operation of the beaters.

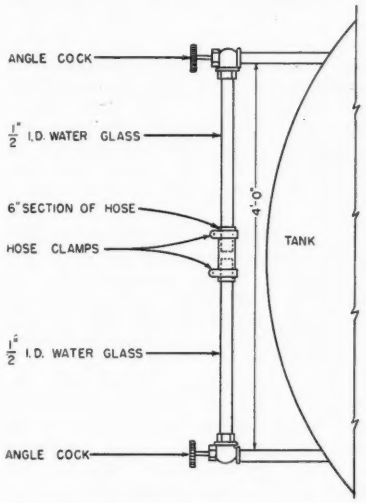
It can be noted that the beaters were closed down at 7:00 a. m. and 11:50 a. m. for a period of several minutes, while at 8:00 a. m. they were slowed down perceptibly for a moment. The chart record provides a means of determining the steam consumption and comparative operation for each shift.

Packing Lubricant

TO KEEP gland packing soft, the use of cylinder oil in which a quantity of colloidal graphite is suspended can be used effectively. Graphite particles penetrate the packings, keeping them soft, allowing more perfect joints and reducing rod scoring. The colloidal graphite has extremely fine particle size which permits complete penetration.

Shock Absorber for Long Gage Glasses

LONG GAGE glasses used to indicate the water level in tanks are frequently subjected to temperature strains and



Rubber hose used as shock absorber on a long gage glass

vibrations transmitted from pumps and other machinery. P. C. Ziemke submits the accompanying sketch of an arrangement he has used to advantage in reducing breakage.

Practical Substitute Materials

MATERIAL SHORTAGES resulting from the increased demands of defense production have led to the use of many substitutes by Westinghouse engineers. Where substitute materials have been used, quality and performance are at least equal to accepted standards, and in many cases it has been found that the substituted material is better than that originally used. From this search for substitutes should come much of lasting value.

Plain carbon steel is an example of how the deficiency of one of many materials used in the making of a finished product may eliminate or restrict the manufacture of the entire article. One of the most serious shortages is that of steel. Therefore, the availability of steel is the controlling factor in the production of a large number of items. Second in importance is the availability of copper for the manufacture of motors so essential for the operation of industrial machinery and everyday home appliances.

Results of the substitution program are: increased manufacturing cost; some inconvenience and delay; and in some instances an inferior but acceptable finish, of which the customer will be informed so that he may know what to expect.

Substitute materials which are now, or will soon be used by Westinghouse to release critical materials for defense and still maintain accepted performance standards

MATERIAL	SUBSTITUTE MATERIAL	APPLICATION
Nickel steel	Molybdenum steel	Shafts, bolts, gears, etc.
Tungsten steel	Molybdenum steel with small % of tungsten	High speed tool steel
Nitriding steel	Chromium steel	Circuit breaker
18-4-1 steel	High carbon, high chromium steel	Blanking dies
Stainless steel	High chrome steel	Electric range heater tubes
Aluminum	Copper	Disk for watt hour meter
	Brass	Shaft for watt hour meter
	Enameled steel	Cover for electric roaster and cooking well for electric range
	Rubber, enameled steel sheets, or plastics	Ice cube trays
	Enameled steel	Ice cube compartment door
	Rubber, capaco brass, plastics, or enameled sheet steel	Parts and agitation of domestic laundry equipment
Aluminum die castings	Sheet steel with waterproof finish	Sockets for outdoor watthour meters
Zinc or aluminum die castings	Steel or brass	Handles and hinges for refrigerators
Aluminum, brass, alloy castings	Cast iron	Luminaire parts for lighting lamps
Brass	Steel plated with copper or brass or gilding metal	Bases for incandescent lamps
Nickel	Nickel plated steel or copper	Supports for incandescent lamps
Spun aluminum	Spun steel	Searchlight reflectors
Aluminum sheet alzak	Iron sheet with high reflecting porcelain enamel finish or glass with silvered finish	Reflectors
Zinc die casting	Cast iron	Fan bases
Silk	Cotton, glass, or asbestos	Insulation fabric
Mulberry fibre	Old rope	Jappaper insulation
Tung oil	Dehydrated castor, soy bean, or citicica oil	Insulation varnish
Aluminum	Plastic	Nose or windshield for anti-tank and anti-aircraft shells

Three Suggestions

By Arthur F. Churchill

HERE ARE a few hints, kinks and quirks which in the past has facilitated my work when in a hurry or when proper apparatus was not at hand.

When replacing a burned-out bulb which is hot, merely slip the paper cover from the new one over the old one, and out it comes without any burned fingers.

Did you ever find that an ordinary hacksaw blade will not cut a wide enough slot for a large screw driver? Just put another one on the saw and the two of them will do the trick.

Quite often we have to saw boards which require a final smooth finish. Do you saw them out and then plane them down afterwards? We just put a disc of sandpaper on the circular saw and make it a combination saw and sander. It really does save work and time. Care must be taken, however, to allow enough material for the saw and sanding.

The Weight of Belting

By W. F. Schaphorst

UNFORTUNATELY there are very few handbooks and catalogs that give the weights of the various types of belts used in industry. I have been able to find the following weights for three types of belting:

Oak tanned .....0.035 lb. per cu. in.
Cotton and
Canvas ....0.026 to 0.05 lb. per cu. in.
Rubber .....0.045 lb. per cu. in.

In computations that I have made, I find that hair belting weighs approximately 0.035 lb. per cu. in. and high grade mineral tanned leather belting weighs about 0.030 lb. per cu. in.

The following table was copied from Bulletin No. 41 of the Ohio Engineering Experiment Station entitled, "Transmissive Power and Stretch of Belting" by Prof. C. A. Norman and Prof. G. N. Moffat:

WEIGHT IN POUNDS PER LINEAR FOOT OF 3-IN. BELTING THICKNESS CORRESPONDING TO SINGLE LEATHER BELTING

Rubber No. 1	0.266
Balata	0.268
Stitched Canvas	0.36
Oak Tanned Leather	0.209
Mineral Tanned Leather	0.162
Hair	0.314
Solid Cotton	0.199
V-belt, rubberized	0.196

It has been noted that the mineral tanned leather belt, which is the lightest of them all, outpulled them all. Stitched canvas belting, which is the heaviest, gave the poorest results. Mineral tanned leather belting pulled 70 per cent more than oak tanned, and 60 per cent more than rubberized V-belt. Copies of Bulletin 41 are obtainable for 25 cents each by addressing the Engineering Experiment Station at Columbus, Ohio.

For average wind conditions, windage or drift water losses may be estimated at from 3 to 5 per cent for spray ponds; 1 to 1.5 per cent for an atmospheric tower and from 0.2 to 0.5 per cent for a mechanical draft tower.

* * *

Overall efficiency of the new Diesel streamliners are said to reach a figure of 27.5 from fuel to rails.

* * *

Research shows that combustion in a Diesel cylinder takes place in three stages. First a delay period with both physical and chemical changes in which the fuel is heated up to the ignition point. Second, a rapid burning of the fuel injected during the delay period. Third, a rapid burning of the balance of the fuel as it is injected.

REFRIGERATING PRACTICE

How to Prevent Annoying Freezebacks

By Merrill A. Radamaker

Details of how an aggravating case of freezeback was corrected in a large cold storage plant by two cooling coils arranged flexibly and piped up so they could be used separately, in series or in parallel

OVERCOMING freezebacks in large cold storage plants has always been a source of trouble to the engineer, especially where he has no temperature man to adjust the expansion valves properly throughout the day to compensate for temperature changes, due to continually replacing commodities for the customers.

To give some idea of the trouble existing in keeping expansion valves regulated in this plant, we have nine floors of freezers, each one of the floors are separated into three compartments. Each one of these compartments have two expansion valves, except three sharp freezer compartments which have three expansion valves each.

There is a total of fifty-seven expansion valves in the freezers. These are divided into three groups supplied by 1¼, 1½, and 1 in. liquor lines running from a compressor room, which is located in a separate building.

In addition to this direct expansion system, we have eight floors of coolers supplied by a brine cooler, located in the compressor room basement. This brine cooler is provided with a valve BP for bypassing the cold return from the freezers, through the brine cooler.

The bypass can be regulated to pass part or all of this return through the brine cooler to the compressor or direct to the compressor. This works very well when the cooler load is heavy, but when we cut down our cooler load we are compelled to pass part or all of this return direct to the compressor, causing the compressor to run cold and at a lower efficiency. To modify the situation we have made the changes explained in the diagram.

Thermometers are located, to indicate the different temperature changes, at the important points of this system. The liquid coils L and M can be cut out completely, using the liquor from the receiver directly by closing valves B and AA, then opening valve A, and by opening the valve on the branch liquor line to provide liquor for the sprays on both the high-pressure and low-pressure cylinders.

K is the liquor header, feeding four liquor supply valves, supplying the evaporating coils in freezers. The 1 in. valve at the extreme right on this header feeds an expansion valve provided on the brine cooler to be used when there is insufficient cold return from the evaporating coils to cool brine to the desired temperature. This temperature would range from 10 to 20 deg. above zero at the brine to the coolers.

A return liquor trap RT is located in the basement, and is provided with a coil L for cooling the liquor to the header K supplying the evaporating coils through the supply valves. This trap acts as a heat exchanger, cooling the liquor in the coil, with the cold return from the trap RT to the compressor. The coil L can be cut in independently by closing valves A, F, G, E and D and opening valves AA, C, H, I and B.

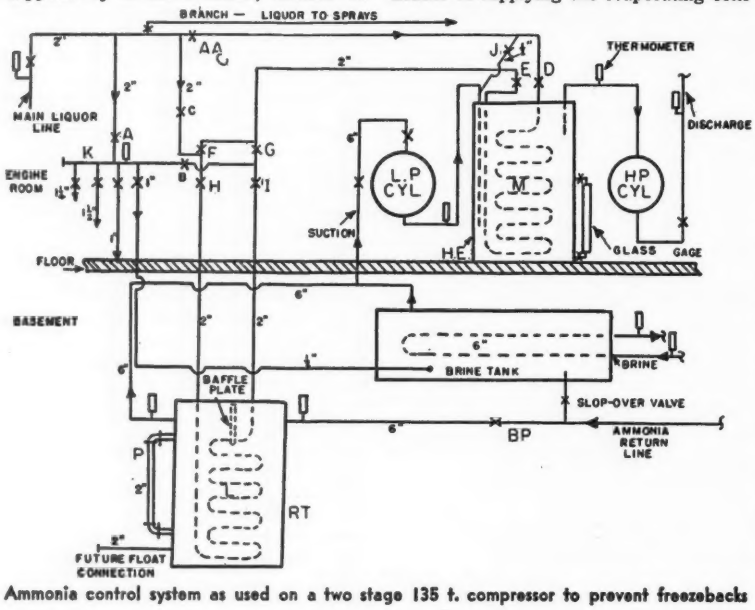
In extreme cases of freezbacks we have supplied this liquor to the evaporating coil expansion valve at 20 deg. below zero and at the same time increase the temperature of the return to the compressor. This trap RT is provided with a future connection for a float. A float would have two distinct advantages: first, it would keep the liquor in the trap RT at a determined level so that it would not fill up and be drawn over into the compressor; second, when the float operates to release the surplus return cold liquor to the ammonia pump which pumps the cold liquor into the receiver it would aid the cooling problem of the liquor in the condensers.

There is a liquor level indicator installed on the side of the return trap RT which consists of two elbows and two nipples threaded into the trap with a straight piece of pipe, indicating the level of the liquor inside the trap by the frost line on the pipe P. Coil M can be operated independent of the other parts of the system by closing valves A, C, H, I and F and opening AA, D, E, G and B. This arrangement is recommended only during shut-down periods of the compressor during the light seasonal or winter load. The vessel HE located as an intercooler between the high and low-pressure cylinders performs more functions than intercooling and should be called a heat exchanger in this case.

When coil M is operating under the above conditions, the expansion valve J is opened just enough to maintain a temperature of the ammonia leaving HE between 40 and 50 deg. F. This keeps the liquor cool through coil M and cools the discharge gas from the low-pressure cylinder to the high-pressure cylinder side. This tends to lower the temperature of the discharge gas from the high-pressure cylinder to the condensers, thus causing considerable saving on power due to lowering compression heat and lowering the discharge gas temperature.

This assists the condenser water in so far as keeping out the excess heat, which otherwise would pass on to the condenser water raising its temperature and again raising the discharge pressure. High-temperature gas would also cut down on the efficiency of the spray tower, boosting the rate of evaporation, necessitating a greater supply of make-up water.

The vessel HE is provided with a glass liquor level gage which would indicate excess liquor caused by manual-controlled expansion valve J being operated improperly or by the compressor running extremely cold and saturated gas condensing in HE. At this point there is a tendency for the liquor to be drawn over into the high-pressure cylinder and cause damage.



Ammonia control system as used on a two stage 135 t. compressor to prevent freezebacks

When the liquor accumulates under any one of the above mentioned cases, shutting off the expansion valve J will correct the condition. Heat exchange through the liquor coil M to the excess liquor in the vessel will cause it to gradually evaporate to the suction of the high-pressure cylinder. There is an oil drain provided in the bottom of HE.

Coils M and L can be cut in series by closing valves A, C and G and opening AA, D, E, F, H, I and B. This system of using both coils in series has proven, in some ways, to have an advantage over operating the coils separately. It will be observed by tracing the ammonia liquor lines and the ammonia gas lines that the heat exchange is improved by arranging the coils as explained above. In this way an aggravating condition of freeze-backs was modified in an efficient manner.

It is also possible to connect the coils M and L in parallel by closing A and F and opening valves C, H, I, AA, D, E, G and B.

To simplify the installation and to clarify the explanation mentioned in this article in reference to the future float connection on RT, it is possible to use a float with an electric contact, operating an electric motor, connected directly to a high-pressure liquor ammonia pump which in turn pumps the liquor from the trap RT to the receiver. The float may be set so that the contact breaks and stops the motor before the tank RT is empty and can be set for maximum or minimum liquor levels.

FOR THE DIESEL OPERATOR

Air-Fuel Ratios for Volatile Fuels

By W. H. Paul[1] and M. N. Popovich[1]

For effective operation it is essential that the proper air fuel ratio be maintained. The best value varies with the type of fuel as a function of the carbon content, also for maximum fuel economy it is higher than for maximum power output. Thus if maximum power is necessary it can be obtained at the expense of fuel economy by using a richer mixture. While this is not strictly a Diesel article, it does throw much light on the problem of fuel variation and the mechanism of combustion in engine cylinders

DURING the past few years utilization of liquefied petroleum gases in internal-combustion engines has undergone considerable expansion. The lighter hydrocarbons, particularly propane and butane, have certain desirable characteristics that make them attractive as fuels for the carbureting engine. Among these are high resistance to detonation, uniform manifold distribution, absence of impurities, and low cost under certain favorable conditions.

An investigation showed that the air-fuel ratios for maximum power and maximum economy for these fuels were considerably higher than for gasoline. In general, fuels having smaller molecules yielded higher air-fuel ratios for maximum power. These air-fuel ratios more nearly approached calculated values for perfect combustion.

Little has been written on the subject of experimentally determined air-fuel ratios for maximum power and maximum economy for fuels other than gasoline. For gasoline, writers report values ranging from 12.5 to 13.5 pounds of air per pound of fuel; this lack of agreement depending upon the operating conditions and characteristics of the engine used. For other fuels, however, only calculated, theoretical air requirements are generally cited. The theoretical air-fuel ratio for gasoline, the formula for which is usually taken as pure octane, C_8H_{18}, is 15.2, which differs materially from the actual values cited above for maximum power. The four most desirable characteristics of a fuel for internal combustion engines are recognized as high resistance to detonation, suitable volatility for good manifold distribution, low sulphur content, and minimum tendency toward gum formation. The liquefied petroleum fuels have a higher detonation resistance than all but the most expensive aviation fuels.

In the matter of cylinder and manifold distribution, gaseous fuels are superior to liquid fuels because they are completely gasified rather than atomized during carburetion. Due to their gaseous nature, liquefied petroleum fuels contain little or no gum or sulphur, as they are recovered in relatively pure form in the refining process.

Although these gaseous fuels contain fewer heat units per gallon, performance and economy can be augmented by increasing the compression ratio of the engine. Possible compression ratios for butane and propane have been reported as 8.5:1 and 10:1, respectively. The authors have successfully used 9:1 with butane-propane mixtures. Unless quite expensive or at least quite heavily leaded gasoline is used, the octane numbers of the liquid fuels will not approach those of the gaseous fuels; therefore, compression ratios used with gasoline will be limited in comparison.

The engine used in the tests was a single-cylinder Delco having a bore of 2.5 in., a stroke of 5 in. and a compression ratio of 6.5. It was directly connected to a 32-v., self-excited, direct-current generator. Curves showing power and economy were made for each fuel investigated and these are combined on Figs. 1 and 2. In the case of the power curves, results for all fuels are plotted in Fig. 1, in which per cent of maximum power output is plotted as ordinate, and air-fuel ratio as abscissa. Figure 2 includes the

[1]Respectively Associate Professor of Mechanical Engineering and Graduate Assistant in Mechanical Engineering, Oregon State College, Corvallis, Ore. Details of the test setup and instruments are included in Bulletin Series No. 14 published by the Engineering Experiment Station.

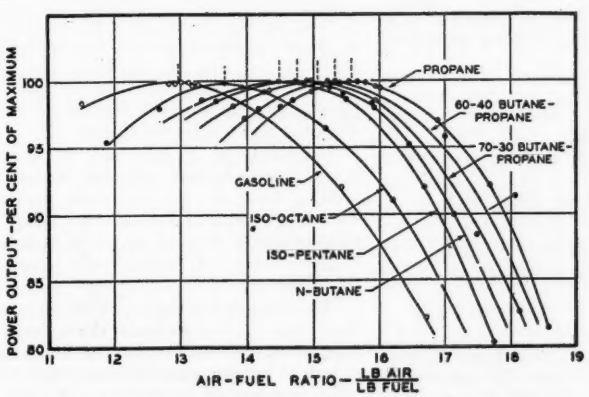


Fig. 1. Optimum power air-fuel ratios for all fuels investigated

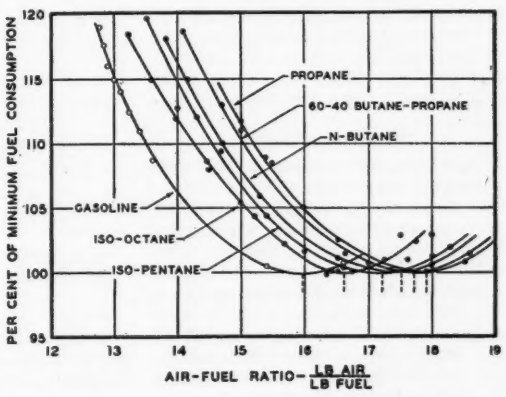


Fig. 2. Optimum economy air-fuel ratios for all fuels

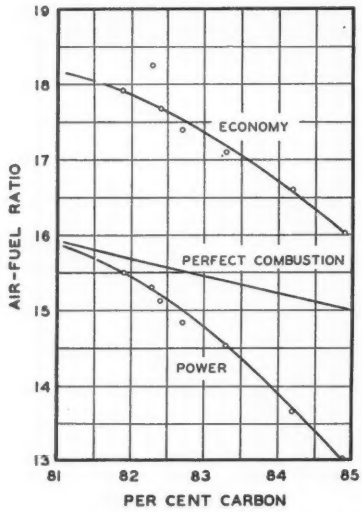


Fig. 3. Optimum air-fuel ratios vs. per cent carbon contained by each fuel. Points from left to right in order represent propane, 60-40 butane-propane, 70-30 butane-propane, butane, pentane, octane, and gasoline

economy curves for all fuels and was constructed with per cent of minimum fuel consumption as ordinate, and air-fuel ratio as abscissa.

It can be seen that the range of optimum air-fuel ratio values obtained for the fuels investigated was fairly wide. The air-fuel ratio for maximum power for propane was found to be 15.5, whereas the corresponding figure obtained for gasoline was 13.0. For maximum economy, the range was from 17.9 for propane to 16.0 for gasoline.

From the maximum power and maximum economy values obtained for each fuel, a curve, Fig. 3, was constructed with these optimum values plotted against the respective carbon contents of the fuel molecules. On this plot are also shown the theoretical air-fuel ratios for the various fuels. Since the carbon content of hydrocarbons in a particular series is proportional to the size of the molecule, the curves demonstrate the effect of molecular size on optimum air-fuel ratio requirements as well as the effect of size on the relative agreement of actual air-fuel ratios with theoretical values. It can be seen that the points obtained experimentally define the curves quite well, although some deviations are evident.

Molecular Size

From Fig. 3 it is apparent that with decreasing molecular size, or reduction in per cent carbon, the air-fuel ratio for maximum power approaches the theoretical ratio for perfect combustion. Since the fuels showed a general trend toward higher combustion efficiency as the molecule became smaller, it would seem that the actual and theoretical values would practically coincide for ethane and methane, two lighter hydrocarbons not included in this investigation.

It is not expected that results obtained with olefines and other nonparaffinic fuels would fall on these curves, but it is probable they would form curves having the same general shape. The factor controlling the degree to which actual air-fuel ratio values approach theoretical values is likely to be the molecular size rather than per cent carbon.

The general shape of the economy curve in Fig. 3 is similar to that of the power curve except for being slightly flatter. It was evident that as the fuel molecules became smaller, the per cent excess air, over the theoretical amount for perfect combustion, increased. This is shown by the fact that the ordinate distances between the theoretical and economy curves increased as molecules became smaller. The maximum economy for gasoline occurred about one air-fuel ratio higher than the theoretical value.

On the other hand, the maximum point for propane occurred over two air-fuel ratios above the theoretical value, definitely indicating a greater quantity of excess air in the case of lighter fuels. This would indicate that leaner mixtures should be used with increasingly light fuels to obtain maximum economy conditions.

Clutches and Power Takeoffs

EVERY ENGINE must have some kind of a power takeoff upon which to mount a pulley, coupling, etc., by which to drive the equipment to be operated. In the smaller engines which have their flywheels and clutches enclosed in a housing, there is a shaft extension provided upon which a pulley, gear, or coupling can be mounted. This extension is usually of sufficient strength and design to stand the side pull of the belt; consequently, no outboard bearing is required.

In the larger engines the power take-off is usually not furnished as standard equipment and is considered as an extra. It is important that it be of proper dimensions and materials so as to be rigid in operation. The power take-off is a shaft which is coupled onto the flywheel by means of a forged flange which is part of the shaft, being one forging, and the flywheel being recessed to act as a register for the coupling to assure proper alignment of the shaft at the flywheel.

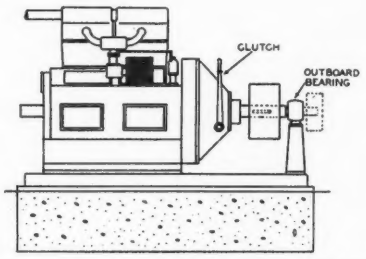


Fig. 1. Power takeoff with outboard bearing extended shaft and clutch. On smaller engines the outboard bearing is sometimes omitted and an overhung pulley used

At the outer end of the shaft there should be a self-aligning bearing with sole plate to allow for adjustment. This bearing should be liberal in its capacity and should preferably be of the ball or roller bearing type. If a babbitt lined bearing, it should be ring oiling.

The length of this shaft depends upon the size pulleys which are to be mounted on it. Frequently several pulleys have to be mounted on it; also, it is sometimes advisable to extend the shaft beyond the outboard bearing so that a pulley may be mounted on it. Where the engine is for direct connection, a very short stub shaft is all that is necessary, only sufficient length being required to allow one-half of a coupling to be mounted.

All gas engines which are started by hand and those which use an electric battery, or a small gas engine using a Bendix drive, should be equipped with a clutch for the purpose of relieving the load when starting. Experience has taught, says the A G A Gas Engine Handbook, that most of the failures with Bendix drives are due to heavy starting duty by having to drag the equipment to be operated in addition to the engine, for which they are not designed.

There are a few exceptions, when the engine operates an electric generator,

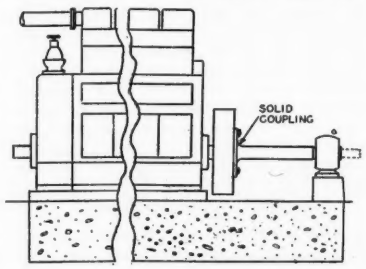


Fig. 2. Power takeoff with an outboard bearing and no clutch. Unless required by the load conditions, clutches are ordinarily omitted on engines started by air

horizontal centrifugal pump, blower, etc., which do not require very much starting torque or power to get them under way.

Gas engines using compressed air for starting usually do not require clutches, as the air pressure used is of sufficient pressure to spin the engine during starting, even when full load torque of the engine is required to start it. However, here again are exceptions.

Frequently it is desirable to shut down the equipment operated without shutting down the engine, or the equipment to be operated consists of a heavy mass which is slow to get under speed. In these cases a friction clutch is very desirable.

There are several types of clutches—the ordinary friction clutch, the hydraulic, electric, and vacuum types of clutches, as well as the over-running type of clutch which is primarily used where the starting torque is heavy.

A Copy of Power Plant Engineering Landed in His Whiskers

PROBLEM 19
THE RISING JACKET-WATER TEMPERATURE

How Would You Do It?

WHAT OUR BOARD OF JUDGES does not know about Diesel engines would fill quite a sizable set of Encyclopedia Britannicas or maybe even the Congressional Library. When they first came across Our Hero's rising jacket water problem it resulted in some weird discussion. One of the old guys who claimed he knew Rudolph Diesel when he ran a steam engine said the trouble was probably in too high a boiler pressure. At this remark other members of the Board burst into loud guffaws (whatever they are) and told the old coot he was nuts—that any group of idiots knew that Diesel engines did not have boilers—that they were driven by electric motors and that in their opinion the trouble was due to a loose nut on the amortisseur winding. Whereupon a third faction arose and deplored the ignorance of their extinguished colleagues because a Diesel engine was a new type of locomotive. There are laws against printing what they said, but the substance of their discussion was that the locomotive driver, Mr. McKenzie, had not used enough anti-freeze in his radiator.

About this time somebody threw a copy of POWER PLANT ENGINEERING through the window and by a strange and fateful coincidence it landed in the chief justice's whiskers. Coming to his rescue, one of his colleagues disentangled the periodical from the brush and before he realized it found him staring at a diagram of a Diesel engine.

So that was it! How simple! Our Hero's problem was as good as solved. The thing obviously didn't have a spark plug and what self-respecting internal combustion engine could run without a spark plug? Where this line of thought might have led had it continued nobody knows but it was just getting good when the replies to the problem started coming in.

How the judges decided on the prize winners nobody knows. These deliberations are secret and it is probably just as well for everybody concerned that the *modus operandi* of selecting the winners remains unknown; it would only create hard feeling. Enough to state that after almost a week of uninterrupted argument, the door of the room in which the judges had been confined by the men in white, suddenly burst open and they announced the first prize winner to be none other than MR. ELTON STERRETT of Houston, Texas! Congratulations, Mr. Sterrett!

Mr. Sterrett quite obviously knows a great deal more about Diesel engines than our Board of Judges and in analyzing Mac's problem he comes right to the point. He doesn't beat around the bush; he doesn't say the trouble might be this or that or if so-and-so were the case then — — —. Not Mr. Sterrett; he says point blank: ". . . the trouble is due to the accretion or building up of a heavy carbon coating on the under side of the piston heads." And then he proceeds to explain why this layer of carbon builds up at that point, why it goes undetected and why it results in raising the cooling water temperature.

This explanation of the trouble seems quite logical, yet Mr. Sterrett was the only one of all the contestants who pointed specifically to this condition. A number of others, true, mentioned carbon accumulation in various parts of the gas system, but no other contestant made it the main topic of his reply.

Of course, there is a possibility that Mr. Sterrett may be wrong. We can only be sure about that when Mac opens up his engine and examines the underside of the pistons.

The majority of replies received placed the trouble in the water system. They were inclined to doubt the more or less positive assertion in the statement of the problem that the water system was okay. They may be perfectly correct in this, but here, again, we cannot be certain until the engine is taken down again. When this time comes we hope to be able to let you know what the real cause of the rise in temperature was.

It was difficult to select the second and third prize awards because so many other letters said the same thing in slightly different words. Mr. Rianhard of Chase Brass & Copper Co. was awarded second prize because of his clear and concise analysis. His approach is very logical and very scientific. After considering all possibilities he finally traces the trouble to the water system.

Leslie Bradley, who is well known to the readers of these pages, receives third prize for also pointing to the water system but he does it quite differently from Mr. Rianhard. In addition he also lists all the other conditions that might contribute to a rise in water temperature. It was this very complete analysis that gave Mr. Bradley a slight edge over some of the other contestants whose answers were considered for third prize.

First Prize Award

Elton Sterrett
Houston, Texas

The gradual rise in jacket-water temperature lies in the fact that the water is being asked to carry away a higher percentage of the wasted heat than formerly. This condition is also true of the increased exhaust temperatures noted. The reason for this apparent heat increase does not lie in the fact that the engine is liberating more heat—for this to happen more fuel would be required, and this change in operating requirements would quickly become apparent to the engineer.

The trouble is due to the accretion or building up of a heavy carbon coating on the under side of the piston heads. Normally the piston, presenting an area, less clearances, approxi-

mately equal to that of the cylinder head, could be expected to absorb and radiate as much heat as does the head. If the lower side of the head—assuming a vertical engine, of course—be clear and in the condition obtaining when it left the plant of the engine manufacturer, it is cooled by the crankcase air circulation of the engine, by oil spray reaching it, and by heat transfer to the walls of the piston.

The building up of an insulating layer of carbon under the head—on the under or crankcase side of the head—shuts it off from the air and oil vapor normally tending to cool it, resulting in a higher temperature of the head throughout the engine cycle, and thus necessitating dissipation of the heat (normally removed by the piston head) through other channels: i. e., the cooling water and the exhaust.

If the engine had a long record of uniform performance, it is probable that the inception of the abnormal rise in temperature can be traced back to one or more of a number of factors, among which might be listed:

1. Substitution of a new type, make or S.A.E. number of oil for that formerly used.

2. Operation of the engine at too high a running temperature for a period of time long enough to permit the oil to begin the formation of a blanket of carbon, after which the condition will continue to aggravate even though the cause of the temporary overheating be detected and corrected before apparent damage be done the engine.

3. Operation with too high an oil level in the crankcase or with excessive feed on the lubricators, depending upon the type of oiling system used, with the result that more oil reached the under portion of the head than could drain away properly.

4. Operation with a change or charge of oil which contained water. Even a small percentage of water may form emulsions within an engine which tend to form gummy crusts when heated or evaporated. Or, as alternative, a leak may have developed which permitted the escape of a small amount of cooling water into the crankcase.

5. Temporary clogging of the crankcase breather outlet, which would be indirectly responsible for condensation within the crankcase of the water vapors carried there by the augmented blow-by occurring when crankcase pressure equalization is prevented. This condensation, slight though it is for each power stroke, can mount up to the point where it is sufficient to dilute or mix with the oil.

Whatever the cause of the carbon deposition, the condition of the engine can be set right by pulling the pistons and cleaning them *inside* thoroughly. In all probability the under side of each piston head will be found to be covered with from one-quarter to as much as one inch of gummy black deposit, burned hard in contact with the metal of the piston head, and spongy and full of unburned oil at the surface farthest from the head itself.

Incidentally, though this has nothing to do with Problem 19, operating at 120 deg. F. outgoing temperature of the cooling water is too low for fuel and/or lubricating efficiency. Both fuel and lubricant consumption will be reduced if the temperature limit be raised, as much as can be carried by the cooling system and engine design satisfactorily. This is proved by the success of many cooling systems now operating as closed circuits, vapor condensation alone being relied upon to produce the necessary temperature drop in the incoming or cooling water.

Second Prize Award
T. M. Rianhard
Chase Brass & Copper Co.
Waterbury, Conn.

It is stated as a fact in this problem that the economy of the Diesel engine is now better than ever in spite of the higher exhaust and water jacket temperatures. It can be safely assumed, therefore, that the percentage of the horsepower output on the shaft to the horsepower input in the fuel is at least equal if not greater than when the motor was first installed and when the water jacket temperature rise was only 12 to 15 deg.

The only heat input to the engine is from the fuel consumed, and since the fuel characteristics are the same, we can assume it to be a fact that the heat input to the engine is the same.

The heat output from the engine is either through useful work via shaft horsepower, dissipation by radiation and convection from the engine itself, through exhaust gases, or through the water jacket. Since the heat output via horsepower in the shaft is the same, we can assume that the heat loss through the last three factors is also the same.

Although the matter of convection and radiation from the engine itself is not mentioned, we can assume that the conditions effecting these are the same and that, therefore, the heat loss through this medium is approximately the same. This would not be the case, however, if formerly the engine had been operating out-doors in cold weather and subject to cold drafts, but was now operating in a warm enclosure with no drafts.

Assuming that the same conditions exist effecting radiation and convection, then the total amount of heat being lost through the exhaust manifold and jacket water must be the same as formerly. Since the exhaust temperatures, however, have risen some 50 deg., it would seem obvious that B.t.u.'s being lost through the exhaust have increased proportionately. Hence, there

PROBLEM 20

WIRING FOR OUR HERO'S NEW HOUSE

Boy! Oh! Boy! is our Hero in a jam now? In the midst of his other grief he got married on Thanksgiving (the second one) and got into two wars at practically the same time. Father-in-law being a substantial citizen had a bright idea and one of the wedding presents was a lot in a subdivision just beyond the city limits. Mrs. Hero must have a house immediately—has it all laid out in fact; single story; living room; dining room; kitchen; bedroom; bath; front and back porches. ¶ Unfortunately she knows too much about engineers and realizes she will be alone a lot at night. Also she is scared of burglars. An old friend of the family, Theron P. Foote of Fairfield, Conn., made some suggestions. Now she wants our Hero to layout the wiring so that she can light or extinguish collectively at least one light in each of the rooms and hall from either of two master switches: one just inside the front door; the other in the larger bedroom. ¶ In addition, the light in each room must be capable of control individually without interfering with all of them being extinguished or lighted collectively from either master switch. Naturally our Hero wants to please her, but does not want to spend all his money for wiring, nor does he want to get it all in and find that he cannot get insurance.

Write out your solution and opinion in a letter of not over 1000 words and send it to the Contest Editor by January 25. A first prize of $15 will be awarded for the best letter, a second prize of $10 and a third prize of $5. Entries should be addressed to the Contest Editor, Technical Publishing Co., 53 W. Jackson Blvd., Chicago, Ill.

must be an equal decrease in B.t.u.'s removed through the jacket water.

Since the temperature rise in the jacket water has increased almost three times while the total heat has actually decreased, then the actual g.p.m. must have decreased to one-third or less than one-third its former value.

The problem states that the pump seems O. K. This wording leads me to believe that this has not been thoroughly checked, and therefore, it should be to see if the loss in circulating water is due to some fault there.

The radiator, which takes the heat out of the water, is doing a good job by reducing the water to 110 deg. so that it would appear improbable that there was any stoppage or scale there. Since it has been definitely determined that there is no stoppage in the engine, the two places where the fault could lie would be in the pump or in the piping. Assuming now that the pump has been checked and found to be in good operating condition, it becomes apparent that corrosion or deposits in the piping have created stoppages which are impeding circulation of the cooling water.

Third Prize Award

Leslie Bradley
Bismarck, N. D.

There are three things that will cause the temperatures to rise in the cylinders and water jackets of a Diesel engine. These are: first, load; second, some disarrangement of the cooling system; and third, the mechanical condition of the engine itself.

According to the problem as set forth by Mr. McKenzie, he has checked his load, therefore if he can be sure of this check the load can be forgotten. Also it seems that he has checked his cooling system for scale, condition of pumps and, as he states, the pressure at the pumps is the same as formerly. However, there is one thing for which he did not check and that is he did not check the velocity or flow of water through the cooling system. In my opinion, the pressure could be the same as formerly and still there could be come condition which has recently developed that has cut down on the flow of water. Not until the amount of water that flows through the water jackets has been checked and measured can Mr. McKenzie be sure that it is not the cooling system that is causing the temperature rise.

It is the velocity of the water rather than the pressure that is the contributing factor in carrying away the heat of combustion. The amount of water that is needed to carry away the heat can be easily and quickly determined by the following formula and Mr. McKenzie can measure the flow of water in his engine by measuring the flow for a determined time and then checking with the figures of the formula.

For his engine and with a temperature rise of 15 deg. in the cooling water he should have a flow of around 90 g.p.m. For 35 deg. the flow would be around 40 g.p.m. In a Diesel engine from 2800 B.t.u. to 4000 B.t.u. will be given up to the cooling water per horsepower-hour. In figuring the above required amount of water per minute, 3000 B.t.u. was used.

The formula is as follows:

$$\frac{\text{3000 B.t.u.} \times \text{Engine hp.}}{\text{rise} \times 60 \text{ min.} \times 8\tfrac{1}{3} \text{ lb. } H_2O \text{ per gal.}} = \text{gal. per minute}$$

If the flow of water through the water jackets is considerably below the 90 gal. as above stated then the trouble is more than likely due to the water flow. Naturally if the water temperature should rise due to some condition outside the engine then the exhaust temperature will rise correspondingly and with the temperatures as given for the rise in the water jackets and that of the exhaust gases, the indications are that the flow of water could be the trouble here. As a rule if the exhaust temperature becomes higher from more load or from some cause with the engine, then the exhaust temperature rise will be much higher than the rise in the water temperature. In this case the differences will be much greater than the difference of the temperatures given.

If the water flow is approximately 90 g.p.m. and he is sure of his load, then Mr. McKenzie will have to look into the mechanical condition of his engine.

The fact that the temperature of the cooling water began to rise gradually over a considerable period of time indicates that whatever is causing it is of an accumulating nature, which makes it rather difficult to find, so a very thorough examination of the engine will have to be made to find the fault. The tabulation below lists the things that would cause higher temperatures in the order of their importance.

Mechanical Causes of Temperature Rise

1. Blow-by in cylinder	Stuck rings Broken rings Worn rings Scored piston rings
2. Clogged exhaust ports or leaking exhaust valves	
3. Scavenging pressure not high enough if a 2 cycle engine	Restrictions in air ducts Dirty filters Damaged breather Leathers or valves Piston blow-by if a crankcase scavenging engine
4. Back pressure in exhaust piping	Caused by carbon building up or some other condition
5. Worn injection nozzles or faulty fuel injection	
6. Bearings — main, connecting rod and piston pin bushings	Improper lubrication Scoring of bearing linings Bearings becoming too tight so as to heat more than usual
7. Time of injection changed	

Any of the reasons tabulated will cause the temperature to rise in the combustion chamber first and then in the cooling water.

General Comment

There were many contestants who attributed the trouble to wear or improper adjustment of the engine. D. P. Sommerville of the University of Pittsburgh is quite convinced that it is due to oil leakage into the combustion chamber. "On the surface," he writes in his letter, "Mr. C. D. McKenzie's 225-hp. Diesel engine seems to be improving with age. This could be readily understood if it were whiskey. However, the mechanical apparatus which improves with usage has yet to be built.

"Mr. McKenzie's plight is undoubtedly caused by lubricating oil leakage into the combustion chambers. The oil rings apparently gave satisfactory service for 3½ yr. after which they started to fail and have been allowing a gradual increase of 'lube' oil consumption over the past 6 mo. The oil is mixing with the fuel and participating in the combustion. (The lubricating oil will vaporize at a higher temperature than the fuel oil, but this should not impede the combustion because of the high temperatures which exist in the Diesel engine.) Actually, the economy of this engine is worse than it was 6 mo. ago simply because their fuel consumption tests are not including the lubricating oil which is being burned. This unmeasured fuel will also account for the increased heat loss in the jacket water and the exhaust gas.

"It is recommended that this engine be given a thorough overhauling internally and it then will return to approximately its original operating characteristics. The compression rings may be nearing the end of their life, in which case it would be better to hone the cylinders and use oversized pistons, since a new ring job probably would not last more than 6 mo. A 'hone job' may be unwise at this time because the Defense Program will make it very difficult to purchase new pistons.

"Mr. McKenzie could possibly increase his economy, after repairing the engine, by increasing the jacket outlet water temperature to 150 deg. F. or 160 deg. F. This would necessitate a reduction in pump size or a by-pass line since the inlet jacket water would still be available at 110 deg. F. The latter method would be lowest cost and might warrant consideration. Soft water, oxygen free, will have to be used for the higher outlet temperature."

Among those who felt that the trouble lies in the fuel injector system, Eugene Botz of Ft. Wayne, Ind., and John M. Drabelle of Cedar Rapids, Iowa, were prominent.

Mr. Botz was quite definite in his opinion. "Since there is no change in fuel characteristics," he writes, "there must be a leak or a gradual readjustment of the fuel system. This leak or adjustment is allowing more oil to enter cylinders which is increasing the cut-off ratio. When the ratio is increased as shown in Fig. 1 from 2 to 3', the pressure remains the same, but as shown in Fig. 2, the temperature rises from T_2 to T_3', and T_4 (Exhaust) rises to T_4' giving the 50 deg. rise in exhaust temperature.

"The exhaust gases heat cylinders, pistons, and exhaust valves and this causes the increase in water temperature. The increase in the temperature of the compressed gases is greater than the increase in the cooling water or exhaust gases. Assuming the exhaust gases to represent 35 per cent of the heat loss, the compressed mixture must have increased some 140 deg.

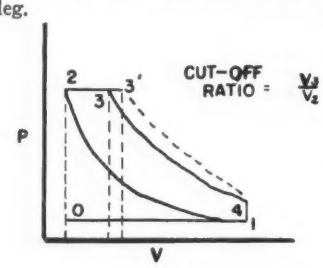


Fig. 1

"An increase in cut-off ratio would decrease efficiency but the increase in temperature of the compressed mixture causes more fuel to be burned nearer to dead center position which means greater efficiency. This is why the professor would run the engine at a higher temperature for in so doing the engine burns more fuel in a way that allows for maximum expansion and thus greater economy."

John Drabelle felt that the trouble was due probably to two factors, both of which are maintenance problems. Quoting from his letter, "As the engine has been operating for some years, wear has developed in some part or parts of the fuel injection system, causing either late or early injection, either of which will cause an increase in the exhaust temperature of the engine and less efficient use of the fuel oil with higher heat losses. To check this an indicator should be used, and pull cards taken, and these checked against typical cards no doubt shown in the manufacturer's instruction book, and if late

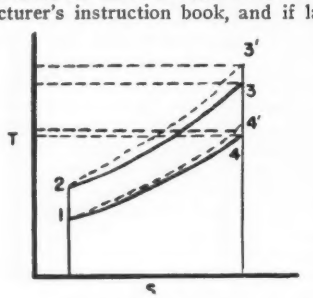


Fig. 2

or early injection is found, then the entire injection mechanism, particularly including the profile of the cams, should be checked, and if wear is found, new parts substituted.

"A part of the difficulty may also be in the centrifugal pump due to wear at the seal rings of the impeller causing a certain amount of by-passing and a reduction in the delivered quantity of water by the pump, and with a lessened quantity of water a higher temperature rise results. This clearance can easily be checked with a feeler gage."

As were many others, Mr. Drabelle was convinced that the engine could well operate with a higher water temperature. "Engine manufacturers," said Mr. Drabelle, "generally recommend low leaving temperatures of water, but if the water is free from scale-forming materials, a leaving temperature of 150 deg. F. as suggested by a professor at the University of Michigan will give a much more satisfactory operating unit and a slightly higher efficiency."

Herman Scott of Oklahoma City deserves honorable mention for his very fine letter. Like Mr. Bradley who was awarded third prize, Mr. Scott also laid the trouble to the water circulating system and like Mr. Bradley he also calculated the necessary water supply for a certain rise in temperature. Quoting from Mr. Scott's letter, "The fact that there has been no increase in pressure would not necessarily mean that there has been no increase in friction head as it is possible that the pump has always been operated at its maximum pressure. If this should be the case there could be no indication of increased head on the pressure gage and any increase in friction would be reflected entirely in decreased flow of water."

With reference to a possible connection between the cooling water situation and the increase in temperature, Mr. Scott's explanation is of interest. "We know the weight of air that can be contained in a given volume decreases as the temperature increases. It follows that with higher cylinder temperatures than formerly, we are getting less air into the cylinders. This means that we are exhausting a smaller volume of gases, yet with the load remaining the same as before, we have the same number of heat units to be removed through the medium of the exhaust. Having a smaller volume of gases they must be at a higher temperature in order to contain the same number of B.t.u.'s."

Among others who suspect carbon deposits, Dean B. Pettit's letter is of interest. He says, "A good place to begin would be to check over the exhaust system thoroughly for carbon deposits. Such accumulations follow the law of the square of the diameter and the restricted area caused by them offers considerable resistance to the exit of the hot exhaust gases. Carbon deposits usually have the habit of building up most where they are hard to get at—points remote from the clean-out holes. (Here he comes very close to Mr. Sterrett's diagnosis.—Ed.) * * * "It was stated that firing pressures were normal, no mention about compression pressures. Perhaps there is too great or small a gap between firing and compression pressures. Compression pressures might be equal to or greater than firing pressures which would tend to cause overheating. All this could be caused by wrong adjustments and sometimes in a small degree by upsets in timing caused by differences in like-appearing fuel oils which ordinary analysis fails to show up. Injection nozzles and pumps should be gone over carefully and placed in first-class condition." Mr. Pettit also directs attention to the scavenging air. "Has the air filter been kept clean? It does not take much dust to impede the free flow of air. * * * Are the automatic air valves that admit and trap the air in the crank case in good order? * * * Do the air seal rings in the crank case seat properly? Are there any leaky sub-base gaskets? * * * If Mac obtains a clean bill of health on all the foregoing he should be well on the way to a cool running engine. If the trouble is not rectified maybe things are not what they seem. Perhaps the load has increased through friction drag or changed operating methods."

Other excellent letters were received from R. W. Neill, winner of Problem 18's first prize, William T. Mullen of Philadelphia, E. L. Stammer of St. Louis, Mo., Sam Williams of Wingdale, N. Y., and Harold Brown of Lombard, Ill.

Mr. Neill, like many others, felt that there was nothing to worry about in the 145 deg. water outlet temperature, in fact, he suggests that it might be responsible for the improvement in efficiency of the engine. The difference between inlet and outlet temperatures, however, should be held to 10 or 15 deg. He discusses various possibilities, but in the end he felt that the trouble was due to low rate of water circulation and not hotter cylinders.

Mr. Stammer also comes to the conclusion that the reason for the rise in temperature "must be a reduction in the number of pounds of cooling water being circulated through the jackets. This reduction in the amount of water circulated results from a mixture of the cooling water with air which is lower in heat absorbing power than the water previously used. Air may enter through the pump shaft packing, or the suction pipe may be taking in air at some point."

Harold Brown's letter listed almost everything that could possibly go wrong with a Diesel engine. From this standpoint his letter is good but in a case of trouble of this nature an analysis should preferably point to some specific cause. The same comment applies in lesser degree to the letters of Mr. Mullen and Sam Williams; both were good letters, but no specific remedy was suggested.

Questions And Answers

Question No. 151

Engineer Needs Help on Hotel Record Forms

WE ARE extremely anxious to find a good practical and usable form or forms for records in a hotel oil burning plant. We would prefer to purchase these forms either in daily forms or in an annual book but have been unable to find any for sale. I would like to know what other hotel engineers do, whether they purchase them all made up, have them printed, mimeographed, blueprinted or planographed, also I would appreciate sample record forms that others are using.

Chicago, Ill. H. C. K.

Question No. 152

How to Cut Pump Packing?

IN PACKING the piston of a reciprocating pump, especially a boiler feed pump which runs hot, I would like to know whether the proper packing size is that which entirely fills the area between the piston and cylinder wall, or whether it is one which leaves, say $\frac{1}{16}$ to $\frac{1}{8}$ in. between the inner surface of the packing and the piston. We are using vulcanized rubber hydraulic packing. Does the kind of packing depend on the inner clearance, if any? What sort of rule, if any, do other readers have for cutting a ring of packing like this? (For both the piston and rod) Certainly it is more than πd, where d is the diameter of the piston or rod; and it is less than πD, where D is the diameter of the cylinder or gland.

A. F. C.

Question No. 124 Answered
Asked on p. 92, August issue

Stoker Control

WOULD it be desirable, asked W. C. Zinn, to change the pressure control on a 125-hp. H.r.t. boiler, used for heating, from a 1 to 5 lb. operating differential to a 3½ to 5 lb. range. Other answers were printed on p. 98 of October issue.

Change Suggests H. E. Z.

IF THE CONTROL setting is changed so that the stoker can cut in at 3½ lb., considerably more heat will be available, which may be needed in severe weather. In mild weather, the higher pressure at cut-in will not affect the performance since ample heat will be available under either setting.

As for economy, in severe weather the new setting will cause more fuel to be burned, but temperatures obtained will be more satisfactory, providing that the present system of operation has not provided enough heat at such times.

St. Louis, Mo. HENRY E. ZEFFREN.

Compromise Says N. T. P.

AS BETWEEN setting the automatic control at a range of 1 to 5 lb. or 3½ to 5 lb., and considering only the economics of it, there is not much difference.

With the 3½ to 5 lb. range the combustion efficiency, that is the efficiency of the stoker, will be higher because the fire will be in an active state most of the time and the excess air will be small as compared with operation ranging from 1 to 5 lb. when the fire will tend to go out during the longer inactive time.

Although with the 1 to 5 lb. range, the stoker efficiency will be lower there will be gains in other directions. The average pressure will be 3 lb. as against better than 4 lb. with the other setting. This means a slight improvement in the boiler efficiency and whatever leaks there are, the loss due to them will be smaller. Also the starting and stopping will be less frequent which is a point favorable to the life of the equipment.

But there is a third alternative which combines the best features of both methods and eliminates some of their weaknesses. Since this plant has operated for several years with the 1 to 5 lb. range that means that 1 lb. is sufficient to carry the heating load. That being the case the automatic control should be set at 1 to 2 or 3 lb.

Chicago, Ill. N. T. PEF.

Question No. 125 Answered
Asked on p. 92, August issue

Well Blow Me Down, What a Hookup

C. W. Z. installed a new 285-hp. H.r.t. boiler with a "blowdown circulating system," as shown in the sketch. It didn't circulate and the unprotected pipe burned badly. He asked five direct questions dealing with the theory; necessity for protecting pipes from direct heat; and on feedwater treatment. Other answers appeared on p. 98 and 99 of the December issue.

He's the Patient, Nurse and Doctor Too!

WHOEVER installed such a hookup should have expected trouble soon and, while it may not have been C. W. Z., it sure looks like he now is the nurse. Now the important thing is that he picked the proper place to ask for assistance, the P. E. & E., Q. & A. Dept., conducted by A. W. Kramer, Editor. *(I resent that, Sir! Mountain goat A. W. K. is harder to keep out than Pulverizer Pete. R. H. M.)*

The first mistake in the sketch is the 1-in. line connected to the wye connection of the pop safety valves. The A.S.M.E. code states that safety valves must be connected to the boiler independent of any valve or pipe connection. Also, that the safety valve or valves be connected to the boiler as close as possible. Drains should be provided on each pop valve to relieve any condensate that may collect. Specific answers to the five questions are:

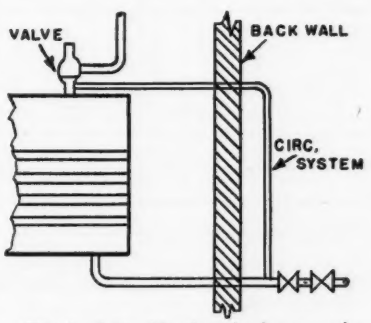
1. I cannot see any circulation in this type of hook-up which will only carry sediment to the lowest point of the blowdown line which is in the direct path of the products of combustion. Also, it is different from a water column both in theory and in the actual construction. Of the two lines to the water column, one, the steam line, comes from the topmost part of boiler or steam space, while the other, or water line, is fitted into the boiler not less than 6 in. below the center line of the shell. These lines are never subjected to the intense heat as is in the case of C. W. Z.'s circulating system.

2. The blowdown line or pipe is always protected by means of a firebrick tier and the horizontal part of this pipe could be inserted into a larger size pipe and packed with asbestos (this method prolongs life of blowdown pipe).

3. It is never good policy to put river water into a boiler without some means of filtration or treatment to remove the sediment.

4. Mud that collects on the inside of a blowdown pipe properly protected from the direct heat of combustion is in a state of sludge because the sediment is suspended in the water and is protected from the direct heat of combustion. When the blowdown valves are opened the pressure forces this sludge or sediment out of the boiler to the blowdown tank and to the sewer.

5. The best way to treat water is to have it analyzed by a well known concern specializing in water purifying and softening systems. There are many concerns of this kind throughout the country, and all you have to do is to look for their addresses in POWER PLANT ENGINEERING Classified Directory located near



This circulating blowdown hookup caused trouble

the back of the magazine. Any of these companies will send a representative from the main or branch office nearest to you.

WILLIAM T. MULLEN.

Philadelphia, Pa.

Find a Proper Water Treatment

1. THERE IS no more circulation in this type of blowdown than there is in a water column, and the scale indicates there was insufficient condensation to keep scale forming water out of the blow-off line.

2. Yes, by all means, all blowoff lines should be protected from combustion chamber gases, as considerable trouble will result from replacing burned blow-offs.

3. No, it is not good boiler diplomacy to use raw water from a river, even if the water be clear, without some form of filtration to prevent the entrance of foreign matter in suspension.

4. No, scale would not collect on a protected pipe, because there is not sufficient heat to assist in the precipitation of scale forming solids onto internal surface of blowoff lines.

5. A simple chemical analysis of the water should show a simple method of treatment that would produce a suitable boiler feedwater, but, a more complete chemical analysis would really be the best.

Quanah, Tex. PAUL F. DICKENS, SR.

Question No. 129 Answered
Asked on p. 90, September issue

Transformers for Light and Power

A. The complete details required, to permit a reasonably accurate answer, have not been given. There is no value of the power load factor. If both power and lighting loads were assumed 100 per cent power factor, then the transformer capacities would be 5, 5 and 20 kw. (or kv-a.) which assumes, of course, that the 20-kw. unit would have a value of impedance enabling it to share its proportion of the load in the proper relation. If the motor load had an 80 per cent power factor and the lighting load 95 per cent power factor, then the respective kv-a. loads would be:

Power 15/0.8 or 18.75
Lighting 15/0.95 or 15.78

The relative calculated capacities of the transformers would then be 6.25, 6.25 and 21.8 again assuming the impedance of the largest unit would be such as to permit proper load division. This would indicate commercial kv-a. sizes of 7.5, 7.5 and 25 which would be ample even though the 115/230 system was slightly unbalanced.

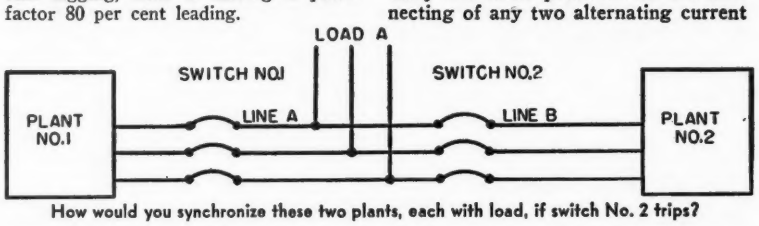
The relative capacity relations of "star to star" connected units would be the same.

Brooklyn, N. Y. C. O. VON DANNENBERG.

Question No. 130 Answered
Asked on p. 90, September issue

How Do You Synchronize a Loaded Generator?

JOSEPH J. ZLABIS, familiar with the technique of synchronizing an unloaded machine, asked for information on synchronizing two plants already loaded, Load A having a power factor 80 per cent lagging, Line B having a power factor 80 per cent leading.



How would you synchronize these two plants, each with load, if switch No. 2 trips?

Close the Breaker with Minimum Load on

GENERAL PRACTICE, assuming the questioner knows the general principles and has all the synchronizing equipment available, would be to connect (synchronize) the unloaded unit (Plant No. 1) to cause as little disturbance as possible during the transition period while raising the load on the incoming machine. The type of driving unit (prime mover) of the generator is not mentioned.

If it is hydraulic or steam turbine driven with an electrical governor control the speed of the unit can be carefully controlled so that, upon closing the breaker, a minimum of load will be taken up by the incoming machine. This will avoid too sudden a change with a possible attendant rise in speed, even overspeeding of the running machine, possible motoring or other undesirable changes in one unit.

With Diesel units, particularly where the load is of a fluctuating nature, it may require some trial to determine how much load can be taken at once, when the breaker of the incoming machine is closed, without causing speed or voltage fluctuations. With steam or hydraulic turbine driven units even when synchronized through hand control little difficulty is experienced after a few initial trials.

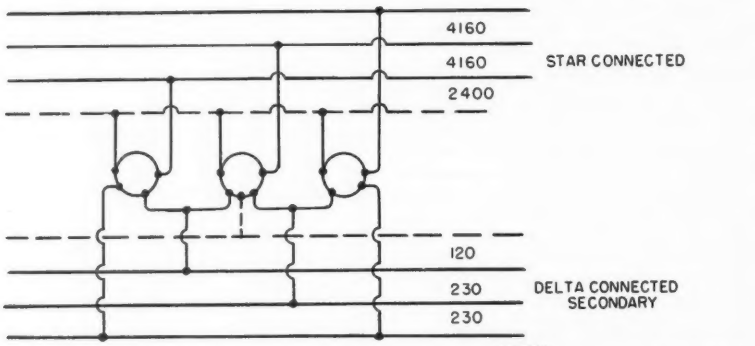
To summarize, bring the incoming unit up to synchronism to take a minimum of load when closing the breaker and adjust the governors and field rheostats to equalize the load as required.

Brooklyn, N. Y. C. O. VON DANNENBERG.

What Type of Load Gives Such Conditions?

A. Question 130 presents essentially the same problems as the connecting of any two alternating current circuits, i.e., "phasing in" at the instant when the frequency and voltage are of equal value, and each wave is at the same identical point or degree of the electrical cycle. Means taken to obtain these conditions are the same in both cases, whether or not the "incoming machine" is loaded. Voltage and frequency of the incoming machine is adjusted to match that of the line, or, in this case No. 2 plant, and the proper matching phase angle determined by means of the synchroscope, and the circuits connected.

The diagram shows isolated plants, so the matter of speed control should be simple. We understand that switch No. 2 is in plant No. 2, so that normally Operator No. 2 would do the synchronizing. Upon the opening of No. 2 breaker, it should be understood, by pre-arranged operating orders, that Operator No. 1 gets his house in order in the matter of voltage and frequency, as nearly normal as possible. It is evident that No. 1 would likely be overloaded, by reason of being isolated from No. 2. Therefore, his frequency would be low, and his units would tend to hunt, or fluctuate in the matter of speed. With No. 1 standing by in as normal a condition as possible, No. 2 adjusts his speed to match that of No. 1, then synchronizes in the conventional manner, and the load is then divided as desired between the two plants. Due to load conditions, the synchroscope would do a merry dance, but a quick eye, a cool head, and a circuit breaker in good operating condition would overcome any difficulty.



C. P. L. wanted to know what size transformer to use with this hookup, how to calculate the size, and what size the units should be for star to star connections?

eration where the evaporators or coolers are filled with liquid ammonia to working level as a steam boiler is filled with water.

Level of the ammonia in the cooler is kept constant by the float which functions in the float chamber. This chamber is common to the cooler by having the equalizing lines as shown to top and bottom. Some of these types of valves are designed having seats for tight closing over a long period, others have the piston valve as shown and all, of course, have stop valves fitted in the line between the receiver and the valve chamber.

Under normal operating conditions these valves are entirely automatic and seldom require any attention.

Kearny, N. J. GEORGE MCNALLY.

How Can He Regulate Blowback? Note the New Question Raised by A. H. P.

Question No. 134 Answered
Asked on p. 94, October issue

JOHN FREMER asks what he can do about excessive safety valve blowdown, which runs from 9 to 18 lb. with the ring screwed down to the limit. I think I can give him an idea for I have had the same experience with safety valves of three different sizes.

My first experience was with a 6 by 18 ft. H.r.t. boiler. The blowdown became so excessive that I finally had to pull the boiler off the line and disassemble the safety. When the bonnet, spring, hand lever, etc., were removed and I tried to pull out the valve, I found it immovably stuck. Eventually I had to turn the city water pressure of 90 lb. into the boiler to force the valve out of the body of the safety valve.

This disclosed, what seemed to me with my experience, a strange condition of affairs. The guide vanes or wings on the under side of the valve were expanded, or the opening in body contracted, so that free movement, limited and governed by the spring tension, was impossible. The vanes were carefully filed, trying the valve at intervals, until it slipped easily into and out of the valve body. When everything was reassembled and steam up, she popped at 100 and blew down exactly to the point at which it had been set to close.

Having had an identical experience three times, and having employed the same remedy each time, I am quite sure Mr. Fremer's trouble is of a similar nature.

I often have wondered what causes this action in a safety valve and would be interested to see the matter discussed in the P. E. & E.

Peterboro Hospital. ARTHUR H. PARKER,
Peterboro, N. H. Chief Engineer.

Perhaps It's the Spring

BLOWDOWN may be excessive at 18 lb. and at a proper limit if it should occur at 9 lb. It all depends on the pop pressure, which is from 25 to 50 times more than the blowdown.

This blowback, the adjustment with the ring, must be made gradually. On most of them, provided it is a pop valve, are notches which can be turned to the left or right. If the blowback ring is turned to the right the blowdown is shortened, but if moved to the left side blowback is prolonged. It is obligatory to turn ring to the right, but only 10 notches, then test again. If the desired result is not obtained it is compulsory to rotate the ring by using 10 more notches.

It may happen that the ring is raised too high, which would result in a dragged blowback. Should none of this operation be successful, I am positive the spring of the safety valve lost its tension.

Glendale, L. I., N. Y. CARL EGERTER.

Cleaning Boiler Tubes

Question No. 135 Answered
Asked on p. 94, October issue

WHAT, asked Homer Hulsey, is the proper method of using an air driven tube cleaner, should it be allowed to feed its way in or be worked slowly backward and forward, overlapping a little each time?

* * *

Move It Forward in Short Steps

EVEN AMONG experienced operators of tube cleaners, one can get an argument as to the proper method of feeding a cleaner. However, after operating the cleaner for a very short time, the operator can tell by the sound of the cleaner and the feel of the hose when the cleaner is in contact with the metal of the tube. Thus the operator avoids leaving patches of scale or coke which always require a waste of time and material to go back and find these patches in the tube.

By cleaning tubes in a backward and forward sweeping action, the operator is always working to a feather edge on the deposit in the tube, which means that the cutting head is at least half of the time in contact with the wall of the tube. This means tube abrasions and rapid wear on cutters, as steel against steel will wear out equipment more rapidly than when the cutters are in contact with the deposit in the tube. Furthermore, the operator is more likely to leave patches of coke or scale, whichever it may be.

In summing up, we believe the best method of cleaning is by working against the shoulder in the deposit in the tube, and when the cutting tool cleans down to the wall of the tube, the operator can judge by the sound that it makes and then progress the cleaner about an inch, forcing it upon the deposit until it again forms a shoulder and cuts to the tube wall. Progressing through the tube in this manner will never leave a patch of scale, thereby leaving a clean tube, saving time and wear on cutters on the cutting head, or drills as the case may be.

Elliott Co. G. L. ELLIOTT,
Springfield, O. Manager,
Tube Cleaner Sales Dept.

Advice—No Pumping Action

IT IS unfortunate that Mr. Hulsey did not give a brief description of his scale deposit, for it would make it possible to give him clearer information on his tube cleaning problem.

The swing frame head is designed only for polishing and has no superior when used for thin soft scale, or, to follow up and polish tube surfaces after more vicious cutter heads have been used. Much power is required to drive the swing frame head at its proper speed for efficient cleaning, hence it is absolutely essential that the motor is tight and sufficient air is supplied to the back end of the motor.

The "pumping action" should not be used to drive a tube cleaner; the heads are designed to have a certain feed by varying the angle of the cutter pins. Best results will be obtained by allowing the head to feed through the tube, for it will advance only as the scale is cut away. If patches of scale are left in the tubes, the feed can be retarded by holding back on the hose.

It is suggested that Mr. Hulsey check his header air pressure, the pressure drop through the lubricator connection and hose, thus determining what the air pressure is at the back end of the motor. For multi-bladed motors the pressure should be over 80 p.s.i., but single blade motors will operate with slightly lower pressure. He should also check the range of the swing frame head and the proper motor O.D. against the tube I.D.

If the motor is being driven at full speed and power and the swing frame or quick repair head does not clean the tubes in one self-feeding pass it is suggested a slightly more vicious expansion head be obtained for the first pass through the tubes, then follow up with the swing frame or quick repair head.

Augusta, Kansas. J. C. DE FOE.

Seems Like a Difference of Opinion Here

IN USING an air driven turbine tube cleaner care should be taken that it is not allowed to feed too rapidly into the tube or the result may be the turbine unit will become locked fast and will entail a lot of brawn, brains, and belly-aching to remove, in some cases the tube may have to be removed after other methods fail.

Before using the regular cutters on the tubes it may be necessary to use the hammer type tool if the tubes are badly scaled. In any case keep moving the turbine back and forth as it is being fed into the tube and of course keep a stream of water flowing into the tube to move the scale and aid in cutting. This can be supplied by a small hose led into the mouth of the tube.

Should the cleaner be forced through the tubes too rapidly only part of the scale will be removed and much of the beneficial effect of turbining will thus be lost. Be careful not to shut the air off while the cutter is feeding into the tube, but always pull back a little to free the load off the turbine before shutting off the air or it may be difficult to start up against the load.

It is also a good practice to oil the turbine after every few tubes have been done and any time the work is stopped. When storing the tool away keep the unit well oiled and protected and the results will be well worth the care.

Kearny, N. J. GEORGE MCNALLY.

Synchronizers of the automatic type could be installed, but due to the infrequency of their use, I doubt their economic feasibility.

It is stated that No. 1 plant is a stand-by unit, and I wonder why No. 2 breaker is set to open before No. 1. It would seem desirable to cut out the stand-by plant, rather than the plant intended to operate continuously. Incidentally, what is the cause of the interruption, and what steps have been taken to remedy it?

Normal variation of power factor will not affect the operation of synchronizing. Are the figures presented (80 per cent lag—80 per cent lead) actually the case? If so, it would be interesting to know what sort of a load is carried.

Wingdale, N. Y. SAM WILLIAMS

Question No. 131 Answered
Asked on p. 90, September issue

How to Repair a Concrete Floor?

THE QUESTION asked by O. J. C. was how to repair a power plant concrete floor in bad condition and not level. Contrary to general custom many of the answers deal with proprietary products made and sold by a specific manufacturer. If the unevenness is not serious and the floor is still in reasonably good shape but showing signs of wear, the application of a floor hardener can be used to advantage. This comes in liquid form and is made by a large number of firms, two of which are the Master Builders Co. of Cleveland, O., and A. C. Horn & Co. of Chicago, Ill. These hardeners are said to do a good job and are very effective in preventing further dusting.

If the uneven condition is serious and the floor is now in very bad shape, it might be possible to put another layer of concrete on top of the old floor. This, however, should not be thinner than ¾ in. and should preferably be 1 in. Whether or not this layer can be added depends largely upon whether or not it would prevent the doors from opening.

Many concrete floors, however, are made with a ¾ or 1 in. topping which can be easily chipped off. The labor cost of this is, of course, considerable but still much below the cost of an entire new floor.

Specifications for the topping, whether it is added on top of the old floor or after stripping the old floor, can be obtained from the Technical Service Department of the Universal Atlas Cement Co. of Chicago, Ill.

Johns-Manville of New York, N. Y., also make an asphalt plank or flooring which can be used effectively in many places. This comes like lumber and is laid in hot asphalt. The Bennett-Colburn Co. of Chicago, Ill., also lays a monolithic asphalt floor in thicknesses of from 1½ in. up, but for a small job the unit cost of this is high due to the installation equipment required. Other answers follow:

* * *

This question can be readily answered by referring to our folder "Over Ruts and Holes", describing the various ways of overcoming floor problems with Stonhard Resurfacer. Over a concrete floor this bonds to a firm feather edge and can be applied to a concrete floor without the necessity of tearing up the old floor surface.

It may be applied on wood, concrete, brick, composition or other types of floors, platforms and trucking areas to give a smooth, nonslipping, damp proof, sound absorbing, spark proof, fire resisting surface. It is resilient, requires no skilled labor or expensive equipment and requires only 36 hr. for setting. Even this time can be speeded up by using a special remix in place of cement. From 1 to 1½ sq. ft. can be covered to ½ in. thickness with each pound of the resurfacer.

Philadelphia, Pa. E. R. BAUER, Stonhard Co.

* * *

FOR REPAIR for concrete floors I have used the Flexrock Co.'s Ruggedwear with no complaints after some 4 yr. of heavy service. Am not interested in pushing this brand as others may be plenty good also, but I have found the material and method the answer to a desperate maintenance man's prayer when it comes to resurfacing bad concrete.

H. B. MCDERMID.

Cincinnati, Ohio.

* * *

THE QUESTION of repairing a badly damaged concrete floor in the power plant of O. J. C. can be readily solved with application of Ruggedwear Resurfacer, a product of the Flexrock Co., Philadelphia, Pa. No chipping or chopping is required in making the repair.

Patches are installed simply by sweeping out the spot to be repaired, mixing the material and troweling smooth. It sticks solid and tight to a feather edge and will not crack out at the joint, for the cellulose processing makes it resilient and tough, not brittle.

Repairs can be made by unskilled help on Saturday afternoon and traffic run over floor Monday morning. Material may be used as a complete overlay if old floor is in very bad shape; can even be installed over old wooden floors.

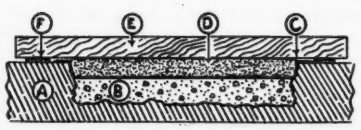
It may be installed to varying thicknesses in order to level out floor and at ½ in. thickness it provides the toughest type of floor for industrial service.

Harry P. Bridge Co., WALTER CHITTICK. Philadelphia, Pa.

* * *

AT THE suggestion of A. R. K., J. L. Brelsford of The Surety Products Co., Cleveland, O., supplied the following information on the company's Surekrete and Surebond. Surekrete mixed in ordinary concrete mix gives a flexible concrete which bonds with the old flooring (wood, concrete, brick, metal, etc.), can be laid to a feather edge and hardens in 36 hr. No special equipment or skilled labor is needed. Surebond is used for priming the surface.

If the floor is dirty, painted or greasy it should be cleaned with Oakite A, Wyandotte Metal Cleaner or Surety Sure-Clean. When holes are deeper than 1 in. a grout mix can be used for fill



Method of repairing holes more than 1 in. deep. A, original floor. B, grout mix for filling. C, bond. D, Surekrete mix. E, strike-off or leveling board. F, shim or screed strips

leaving space for about ½ in. of Surekrete mix at the top as shown by the accompanying sketch.

Question No. 133 Answered
Asked on p. 94, October issue

What Is a Double Ported Expansion Valve?

BRIEFLY, C. W. P. wanted to know what a double ported expansion valve is, how it works and what are its advantages?

* * *

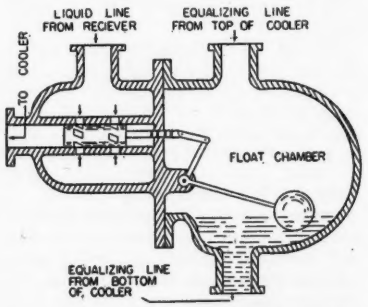
IT IS NOT made clear whether the expansion refers to steam or refrigeration. If a double ported slide valve is meant then the advantage lies in the fact that the same amount of steam can be handled by the valve with only half the travel of an ordinary slide valve. This, especially when applied to valves of heavy construction means a considerable saving in wear, tear, and power.

Some types of slide valves are also called expansion valves when fitted with a riding cutoff valve on the back of the main valve.[1] The purpose of this is to change the point of cutoff with the load so as to get the maximum efficiency by expansion. Diagrams and descriptions of these and other types of steam valves are found in almost any text book on engineering.

This leads me to believe that the valve in question is for refrigeration. Several designs of double ported valves have been applied to this purpose, sleeve valves, needle valves with double seats and other types.

The attached sketch of the float-controlled, double ported expansion valve is the type used on larger installations having the flooded system of ammonia refrig-

[1]For details of a modern riding cutoff valve with directions for setting see *Valve Setting De Luxe* by E. M. Paullin, p. 556 September, 1938.


LIQUID LINE FROM RECIEVER
EQUALIZING LINE FROM TOP OF COOLER
TO COOLER
FLOAT CHAMBER
EQUALIZING LINE FROM BOTTOM OF COOLER

Details of a double ported, refrigeration expansion valve as described in the text

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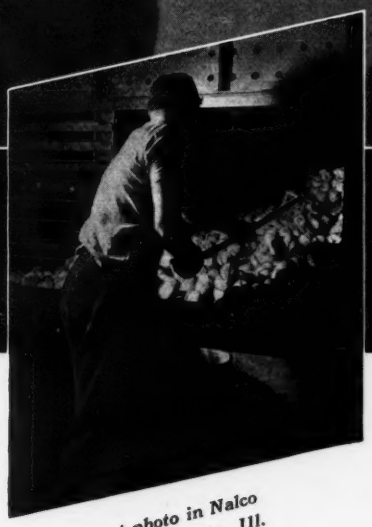

Inset photo in Nalco plant, Chicago, Ill.

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LETTERS AND COMMENTS

ANY IDEAS TO HELP UNCLE SAM WIN THE WAR?

While the following letter was received before the Declaration of War, it is extremely timely. It is also worth noting that many of the suggestions have already been adopted by the Office of Civilian Defense (see New Engineering Books in this issue for a list of many O.C.D. publications now available). Speaking on this same thing at the recent A.S.M.E. Convention in New York, Colonel L. B. Lent outlined the activities of the National Inventors' Council, and said in part:

"Some revolutionary new weapons submitted to the council are now under test and development and may, some day soon, be heard from in tones not pleasant to the Axis powers.

"It may also interest you to know that of the ideas having potential value to the armed services, about 40 per cent are in the general field of ordnance, which includes all kinds of guns and ammunition and also tanks, amphibians and fire-control devices, about 20 per cent are in the field of aircraft, including power plants and flying equipment, and, the remaining 40 per cent encompass all other phases of warfare. A relatively large number pertain to geometric and optical instruments and to radio and other electrical devices.

"The number of devices and ideas which are of potential value is quite surprising and indeed most encouraging. As you may imagine, we do have many suggestions of what are sometimes called "crack-pot" variety.

"Such suggestions, however, receive full consideration, for in them may lie the germ of the worth while idea. Those who submit them are obviously working in an unfamiliar field or are uninformed respecting even the fundamentals which may underlie their invention . . . daily consideration of these cases brings a growing conviction of the need of a larger percentage of ideas coming from those who know their subject.

"Of course, we have had death rays, none of which have yet killed anybody. We've had several schemes for robot airplanes or projectiles which chase other airplanes, but the inventors' ideas are usually general suggestions, the details of which must be worked out by others, if the thing is to work as the inventor thinks it should. However, there is hope, at least, in this field.

"And—as in the last war—we still have all kinds of plates and nets to keep torpedoes away from Naval vessels, but which would slow the speed down to a walk and make the ship unmanageable in rough weather. But—as previously intimated—don't be too surprised if something radically new and potent comes to light before this present scrap is over."

IN THE President's broadcast to the nation last spring, he called upon every man and woman to make a sacrifice and to help prepare our country against any and all agressors. No true American, native or naturalized, will fail to heed this call. Not the least of those who can be expected to co-operate is the stationary engineer—the chief and all his helpers and assistants.

The engineers of our power plants, large and small, are accustomed to sacrifice, not sacrifice in the sense of martyrdom but in the sincere adherence to duty. The engineer makes many sacrifices in ordinary everyday life. It makes no difference what the type of his plant, whether it serves a mine, mercantile building, hotel, industrial plant, water works, or hospital, in every case the engineer does his work conscientiously and works long hours without complaint. These men, the chief and his assistants, are men of skill and training. Many have come up the hard way and have received many hard knocks, but always they come up for more.

All of our craft, from the engineer in the smallest power plant to the chief engineer in the largest plant is ready to help to the best of his ability, and not wishing to boast, the engineers have the ability. This ability was acquired by hard work and long years of experience and not accomplished by sitting on a swivel chair behind a mahogany desk. The engineer sitting in the chief engineer's office was the engineer (fire or oil or mechanic) of yesterday, and well deserves the fruit of his hard work.

If any stationary engineer throughout the country has any ideas which might help the cause, I would suggest that he forward them to the office of Civilian Defense or other proper authorities in Washington, D. C., or, to the authorities in his own community.

I am forwarding some suggestions just to get our craft started and I am sure many good ideas will follow. Some of these suggestions may be practical and workable in a large city, but not workable in a small town. The large cities, small cities and towns are all in this program.

In our large cities, if an air raid occurred and the power house were put out of service, what would become of our every day life? No lights, no power. How important a part will the Diesel engine play in this program in the large cities where ground space is at a premium? With the Diesel engine plant, it would be possible to store more B.t.u. per cubic foot of oil than with coal.

Many plants of all descriptions have a breakdown service from the utility company to supply current for an emergency on Sundays and holidays when the load is too small to operate the plant on an efficient basis. If the utility company can supply the isolated plant in an emergency, surely a solution can be worked out for the isolated plant to return current to the public utility company. This is a workable and practical plan but would require additional equipment such as rotary converts and transformer, as many isolated plants use direct current and most utility plants generate alternating current.

A possible interruption of the water service is also a big problem. How can it be solved? As far as the writer can see, a storage tank of ample capacity would supply sufficient water for 24 hr. service. Then this plant could operate until the emergency were over, and service was normal. This tank could be built under the engine room floor.

If the water mains were bombed, what is to happen to the fire protection? It is impossible to fight a fire without water. What is the solution to this problem? In some of our large cities, the engine room and all the equipment is three or four stories beneath the sidewalk. A well could be developed with a centrifugal pump of the submerged type to pump into the fire stand pipe, or into a Siamese on the building line, to make it available for the fire department's use. The engineer, his assistant and the crews in these plants would be a great asset in aiding the fire department in an emergency.

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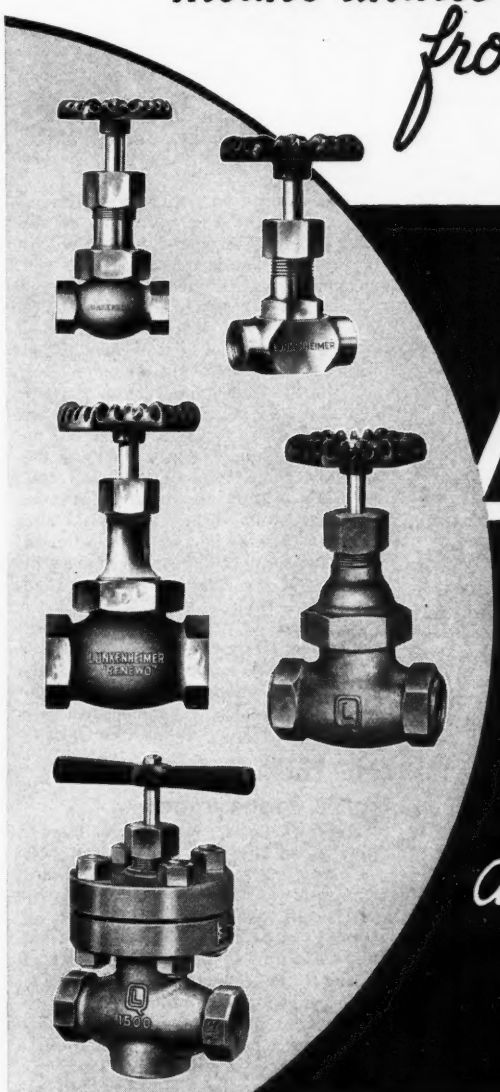

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In connection with the Civil Defense organization the Mayor of every city and town throughout the country should deputize the engineer to assist the fire department in every way possible should a catastrophe occur. The engineer and his assistant is familiar with the sprinkler system in large buildings and factories, and is well qualified to handle them.

In some large cities, the fire underwriter compels the engineer to appear and examines him as to: qualifications to handle the sprinkler system; the location of the fire stand pipe; capacity of tank; how to repair the sprinkler system; where master valves are located; capacity of air compressors and also, the fire pump, etc.

For the duration of this Defense Program, many other ideas will be forthcoming, and the Defense Program needs them. The engineer throughout the year solves many difficult problems in his plant and should be able to help Uncle Sam solve his problem now that our country is virtually but a great defense laboratory.

PETER J. GILLEN
Supervising Eng., Dept. Water Supply, Gas & Elec. (Pumping Division)
Brooklyn, N. Y.

Paralleling D.C. Generators

By Donald Osterhoudt

IN LOOKING through my 6th Edition of POWER PLANT ENGINEERING Questions and Answers book I find nothing about paralleling two or more 3-wire direct current generators. I am under the impression that 3-wire direct current generators are more common than balancer sets which take up the majority of space alloted to 3-wire systems not only in the Q. & A. but in several electrical handbooks that I have. Why this is I don't know, but, just in case other readers may be interested in this particular problem, I am enclosing a diagram of two 3-wire current generators paralleled.

One of these is an Allis-Chalmers 125-250 v., 1200 amp., 1200 r.p.m. machine with interpoles, the other a General Electric 125-250 v., 1200 amp., 100 r.p.m. generator without interpoles.

Gibbons on Pef to Mingle

"Smoke abatement," said J. G. Mingle in an article on p. 66 of the December, 1940, issue, "is largely a matter of proper smoke stack sizing." Wm. H. Grover (p. 87, February, 1941) and N. T. Pef (p. 90, August, 1941) took issue with the author who defended his position (p. 94 of the June and p. 92 of the October, 1941, issue) told why Kents well known table is no longer reliable and discussed various points of boiler operation brought up in the controversy. Sam Williams (p. 95, July, 1941) complimented Mr. Mingle on "seasoning an old subject with new thought" while Mr. Pef intimated he was "writing with a book on his lap." Inasmuch as the discussion was veering from engineering to personalities, we requested Mr. Mingle to forego further discussion until after the publication of his article with newly calculated tables intended to replace Kent's for modern conditions. This article has been in our files for some time and will appear in an early issue. The following discussion will be the last on this subject until then.

* * *

THE COMMUNICATION of N. T. Pef, entitled "Pef to Mingle" on p. 93 of the November issue, undoubtedly correctly describes, in a general way, the different effects which closing the smoke flue damper has upon the production of smoke in oil fired and stoker fired boilers.

Coal has what may be called a self banking property, and when the air is reduced by choking the chimney draft, the rate of combustion automatically adjusts itself. In fact, this is the accepted method of regulating the rate of combustion. As coal gives off comparatively little volatile, and, as that amount is largely a function of the rate at which the solid matter is consumed, which again depends almost entirely upon the air supply, little if any, smoke is produced, for there is almost always enough air to properly consume the volatile.

In the case of gas, or oil which is really the same thing as oil will not burn as a liquid and must first be gasified, the amount of fuel completely or partially burned, is not dependent upon the air supply. If the damper is partially closed, unless the oil feed is adjusted, the same amount of oil will be feed into the furnace. But owing to the shortage of oxygen, although all of the oil will probably be partially burned, it will not be completely burned so that soot and smoke will result.

As a matter of fact, the smoke flue damper in an oil fired boiler should never be used in an attempt to control combustion. The only proper function of such a damper, is to shut off the boiler completely, when not in use. In some localities a damper which will do that is not permitted.

Any attempt to throttle the exit for the products of combustion in an oil fired boiler, is distinctly dangerous, for if the combustion is not complete, as will certainly happen if the air supply is insufficient, we are likely to get an explosive mixture with all its hazards.

The only safe way to control an oil burner is by means of the oil supply cock and the air intake damper. A damper regulator may be used for this purpose, but in no case, should it be hooked up to the smoke flue damper but only to the air intake damper, the oil regulating cock, and with a steam atomizing burner, the atomizing steam cock. Care should also be taken that the damper is so adjusted that it will supply the correct amount of air for the complete combustion of all the oil fed through the oil cock.

The case of gas is, of course, practically the same as that of oil, but in either case, it cannot be too strongly emphasized, that working the smoke damper is no way to control combustion.

Bloomfield, N. J. JAMES O. G. GIBBONS

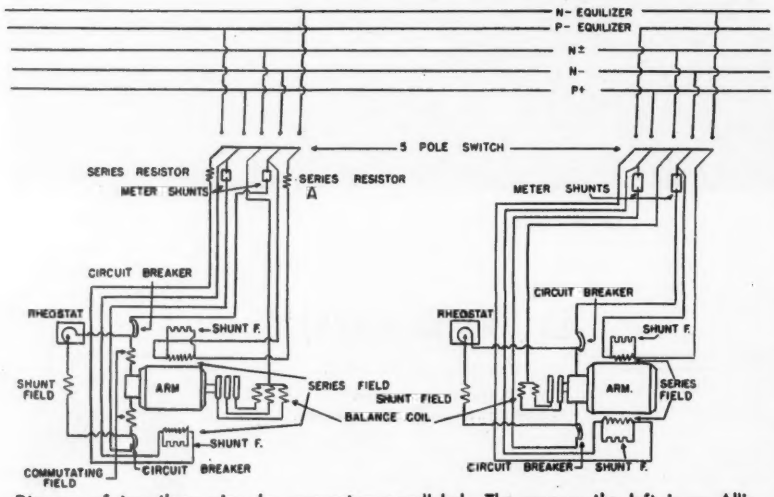


Diagram of two three wire d.c. generators paralleled. The one on the left is an Allis-Chalmers 1200 r.p.m. generator with interpoles, the one on the right a G.E. 100 r.p.m. generator without interpoles. The series resistor A is used when the two are paralleled

He Took Time Out for a Honeymoon

SAY, what's happened to "Our Hero?" Boy, how I miss that guy, for somehow he makes my job seem easier. When I read of his headaches I should really relax and say, "Well, someone else gets all jammed up too," but then I sit right down and start to worry for the both of us and try to help out as much as I can to untie the knots in the problem he had.

Now for the past few weeks the guy don't have a breakdown, a new installation; not even a leaky valve stem. *He can't do this.* Here I had myself all geared up to take care of the worries for both of us and now suddenly up pops a bigger problem than ever, How to stop worrying about what's happened to him?

Last month when he didn't show up on the problem business I said he must be on his vacation. Now this month and still no problem. What's wrong? Do you realize that there are hundreds, yea thousands of engineers who lie awake nights (or days) wondering how one guy can have so much trouble, and, have taken him under their wing (so to speak) and started worrying for him. So call him up and see if he hasn't a new one for his Headache Club.

Buffalo, N. Y. HAROLD E. GETHOEFER.

The Betz Organization is devoted exclusively to consultation, research and supervision in the field of water conditioning . . . from plant design to plant operation. In the solution of any and all water problems, Betz renders a complete service.

W. H. & L. D. BETZ

General Offices: GILLINGHAM and WORTH STS. (FRANKFORD)

PHILADELPHIA • PENNSYLVANIA

REPRESENTED IN ALL INDUSTRIAL AREAS OF U. S. A. AND CANADA

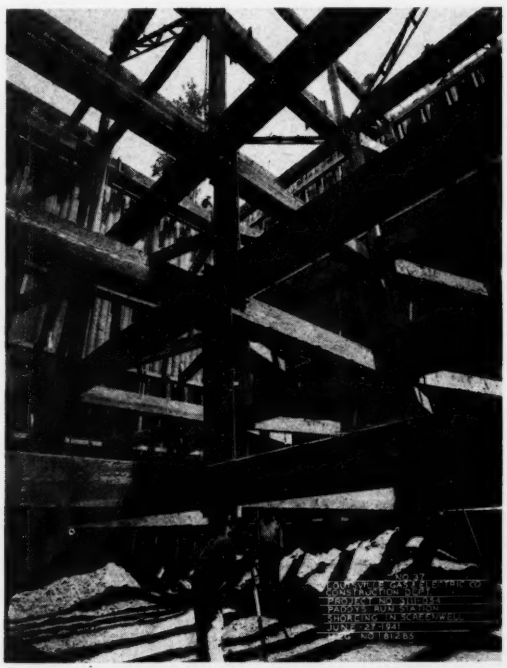
SHOP TALK

A department showing by means of photographs how engineers in various plants have overcome certain obstacles or devised methods to facilitate operation. If you have done something along similar lines that you are proud of or which you feel may be of interest to others, send us a picture and a paragraph of explanation. If the photograph is good and if the idea is original we will present it on this page and pay you for it.

GOOD HOUSEKEEPING. This is not intended as a horrible example of plant maintenance, but to show what Gene Roberts and his gang at the Southwestern Public Service Co., Carlsbad, N. Mex., were up against after a recent flood. Water went over the top of the generator twice before it finally subsided.

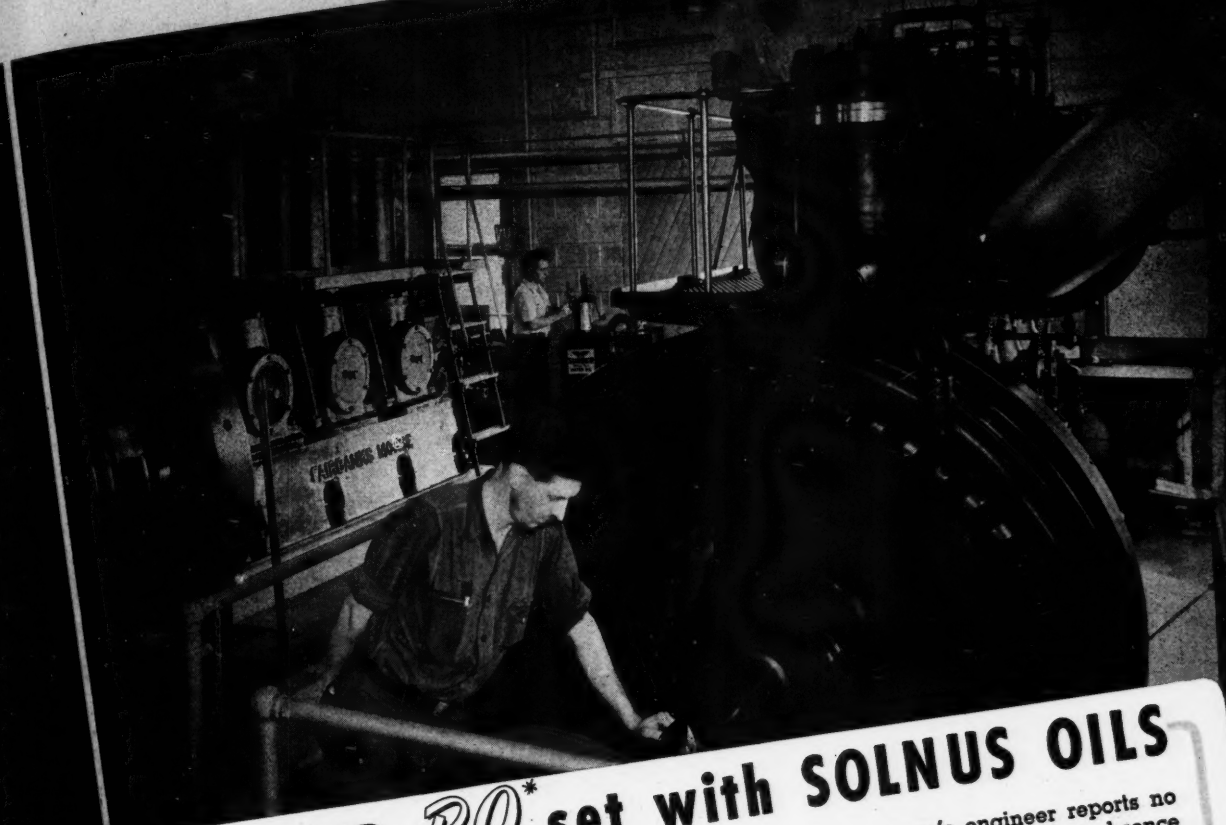
PUMP. The Forest Products Corp. operates several plants around Nowata, Okla., producing oil through "repressuring" the wells by water flooding. Water under pressure is pumped below the oil to force it upward into pockets and eventually to the surface through wells. Water for this purpose is, in one case, taken from a creek in which the water level fluctuates widely. The pump, mounted on a truck with flanged wheels resting on a track made of pipe, is raised or lowered in accordance with the water level by a winch not shown in the photograph. The pump, driven by a 50-hp. motor, is a Byron Jackson Belton and may be operated in any position, horizontal, vertical or inclined. The capacity is 30,000 bbl. per day against 75 lb. pressure. The discharge line leading to the settling pond has tees every 12 ft. for attachment of the high-pressure flexible rubber discharge hose from the pump to the line.

RUBBER HOSE. Those who saw the movie "Manpower" (Edw. G. Robinson and Marlene Dietrich, rated about 1½ stars by our Movie Review Dept.) must have marvelled at the careless way the linemen scrambled over hot 220 kv. towers—always in a heavy rain. Real linemen, however, handle anything over 125 v. with respect. Francis E. Nelson, City Overhead Div., Union Electric Co. of Missouri, St. Louis, uses this picture to show how rubber line hose is used by linemen as hotwire protection.



TIMBER MODELS. Paddy's Run Station of the Louisville Gas & Electric Co. (see p. 48 November 1941 issue) has a separate screen house over 100 ft. high, about 60 per cent of this being below ground level. Sheet piling was driven and the excavation made with a clamshell bucket. Bracing to support the piling, and at the same time leave a well in the center for the bucket, was worked out by A. B. Doudna, structural engineer of the company's Special Construction Dept., and his son, using light balsa wood models.

5,002 HORSEPOWER HOURS PER GALLON



HIGHER *P-Q** set with SOLNUS OILS

This diesel owner knew from past experience that of all the lubricating oils he had used, Sun SOLNUS OILS were first in performance.

When power demands increased and a new 4 cylinder, 300 H.P. engine was installed, it naturally was started up on SOLNUS OILS. The results of the first 9 months run—written in the power house log—tell a startling story. For every gallon of SOLNUS OILS consumed, an average of 5,002 hours of horsepower were produced! Not the slightest trouble has been encountered, and the diesel manufacturer's engineer reports no signs of wear and almost complete absence of carbon deposits.

That's a mighty high P-Q* (Performance Quota). How close does the record of your diesels approach it? Why not take advantage of the outstanding qualities of SOLNUS OILS, the modern diesel oils that are

- **WHOLLY DISTILLED**
- **NEUTRAL IN ACIDITY**
- **DURABLE**
- **LOW IN CARBON CONTENT**

Call in a SUN "Doctor of Industry"—a diesel lubrication expert—for specific recommendations. Write SUN OIL COMPANY, Phila.

**SUNOCO*Performance Quota*

SUN PETROLEUM PRODUCTS HELPING INDUSTRY HELP AMERICA

Industrial War News

(Continued from Page 84)

Ship a Day Goal

SHIPS being constructed under the Maritime Commission's augmented shipbuilding program were scheduled to slide down the ways in December at the rate of one a day, the Commission reported. "A ship a day" was the goal set last February when the emergency shipbuilding program was inaugurated, and with that goal now being reached, the Commission is planning a further speed-up in launchings. From January 1 to November 30, 1941, the U. S. Navy commissioned 27 combat ships, 41 were launched, and keels were laid for 128, the Navy Department recently announced. This includes: battleships: commissioned, 2; launched, 3; keels laid, 2; aircraft carriers: commissioned, 1; keels laid, 3; cruisers: launched, 6; keels laid, 18; destroyers: commissioned, 14; launched, 19; keels laid, 80; submarines: commissioned, 10; launched, 13; keels laid, 25.

Diesel Net Tenders

DEFENSE of the Atlantic seaboard was strengthened recently when the last of a dozen speedy, new U. S. Navy net tenders went into service from shipyards in Ohio. Detailed to tend anti-submarine nets strung across U. S. harbors, the 150 ft., Diesel-driven boats are important factors in the control of ship movements along the approaches to our coastline. The 700-t. ships will develop 1000 s.hp. and will each mount one 3-in. gun and two 50-cal. anti-aircraft guns. Their crews will consist of three officers and 37 men.

Alcoa Power from Glenville

TWELVE MILLION more pounds of aluminum were, in effect, added to the nation's production of this strategic metal, when the Aluminum Co. of America recently put into operation its 27,000 kv-a. hydroelectric power project at Glenville, N. C. This is the fourth of the Company's power projects of the Great Smokies and will have the highest head of any hydroelectric plant east of the Rockies, 1215 ft. from high water level in the dam to the tail water wheel in the plant. A single 27,000-kw. Allis-Chalmers hydro unit is coupled to two Allis-Chalmers impulse wheels, each rated at 15,000-hp.

Interconnection Ordered

THE FEDERAL POWER COMMISSION declared a power emergency to exist in the northern part of Virginia, particularly in Alexandria and in Arlington, Fairfax and Loudoun Counties, and ordered that a new high capacity interconnection be installed immediately between facilities of the Potomac Electric Power Co. and the Virginia Public Service Co. to meet power needs in the area.

This interconnection will be made through a new heavy duty cable extending under the Potomac River from Pepco's facilities in the District of Columbia to or near the new War Department office building in Arlington County on the former airport site. Delivery will be made via facilities of the Braddock Light and Power Co.

The interconnection will increase the capacity available to the Virginia company approximately one-third and will consist of transmission facilities, including transformers and other equipment, approximating 30,000 kv-a. Pepco is ordered to deliver from its available capacity up to 30,000 kv-a. as necessary to relieve the present emergency, and, to obtain power for the interconnection from such other sources in the event it cannot supply requirements from its own facilities.

Rules for Production Associations

DUBIOUS promoters seeking commissions on defense jobs were barred from participation in defense production associations December 8 in a bulletin sent by Floyd B. Odlum, Director of the Contract Distribution Division of O.P.M., to 81 field offices. Defense production associations are being organized by groups of small manufacturers in many sections of the country to seek and execute defense contracts or subcontracts they cannot handle individually.

Under present policy, clearance will be limited to the following cases: An association representing manufacturing units in a given community or industry, (a) sponsored and organized by the members themselves, (b) or by public or civic agencies acting without profit, (c) by a manufacturing concern equipped with physical facilities for participation in the performance of contracts or to provide substantial services in connection with such contracts by other members of the association.

As a corollary to the foregoing, the following rule will be applied: So-called defense production associations, organized or sponsored by third parties for the purpose of inducing membership of manufacturing units upon an agreement to pay a percentage of the amount of defense contracts obtained will not be cleared.

Individuals or groups desiring to form defense production associations are advised by Mr. Odlum to notify the nearest field office of the Contract Distribution Division.

Mines, Foundries and Machine Shops Benefit

MANY SMALL foundries and machine shops in areas where mining operations are carried on, as well as the mines themselves, will benefit by an amendment to Preference Rating Order P-56, announced December 2 by the Priorities Division of O.P.M. Order P-56 facilitates the acquisition of repair, maintenance, and operating supplies by mines.

The clause in the amendment which is particularly helpful to local enterprises is the one which assigns an extendible rating of A-3 to the acquisition of new mining machinery, and of repair parts, by a mine operator.

Preference Rating Order P-23, which extended a rating of A-3 to the acquisition of materials entering into mining machinery, was issued only to known manufacturers, and hence was not available to the many small businesses which will now be able to fill a portion of the mines' requirements. Order P-23 is not affected by the amendment.

Other clauses in the amendment assign an A-1-a rating to deliveries of materials when there has been an actual breakdown or suspension of operations; an A-1-c rating to deliveries of material up to the minimum required to make reasonable advance provisions; an A-3 rating to deliveries of essential material or equipment; an A-8 rating to deliveries of essential machinery or equipment of types other than those listed in the schedule.

The amendment also extends the benefits of the order to refractory plants wholly engaged in the processing and burning of refractories, and to approved prospecting enterprises.

Applications, and inquiries concerning Preference Rating Order P-56, should be addressed to the Mines Priorities Section, O.P.M.

"Flight Strips" Along Highways

CONSTRUCTION of Flight Strips along the public highways is authorized by the Defense Highway Act of 1941, which has been signed by the President. The Army Air Forces will co-operate with the Commissioner of Public Roads in the selection of locations and construction of these auxiliary landing areas, the War Department announced recently. Construction of Flight Strips in most instances will involve little more than widening the highway rights-of-way, or, the use of roadside development areas, and establishment of a definite line of demarcation between the highway and the Flight Strip.

Labor Force and Army Needs

UNITED STATES has "virtually no immediately available reserve of workers left in most of the essential defense occupations," Lt. Col. Joseph F. Battley, chief of the Labor Div. of the Office of the Under Secretary of War, told a conference of Army and Navy officers and O.P.M. Labor Division officials gathered in Washington December 5 to discuss problems of labor supply throughout the New England and Middle Atlantic States.

Active competition between the armed forces and industry for the young, the physically superior men must cease—there just aren't enough to go around, he asserted. Emphasizing the need for employment of persons not qualified for military service, Col. Battley declared that employers and training courses have neglected those "over age," those physically disqualified, and women.

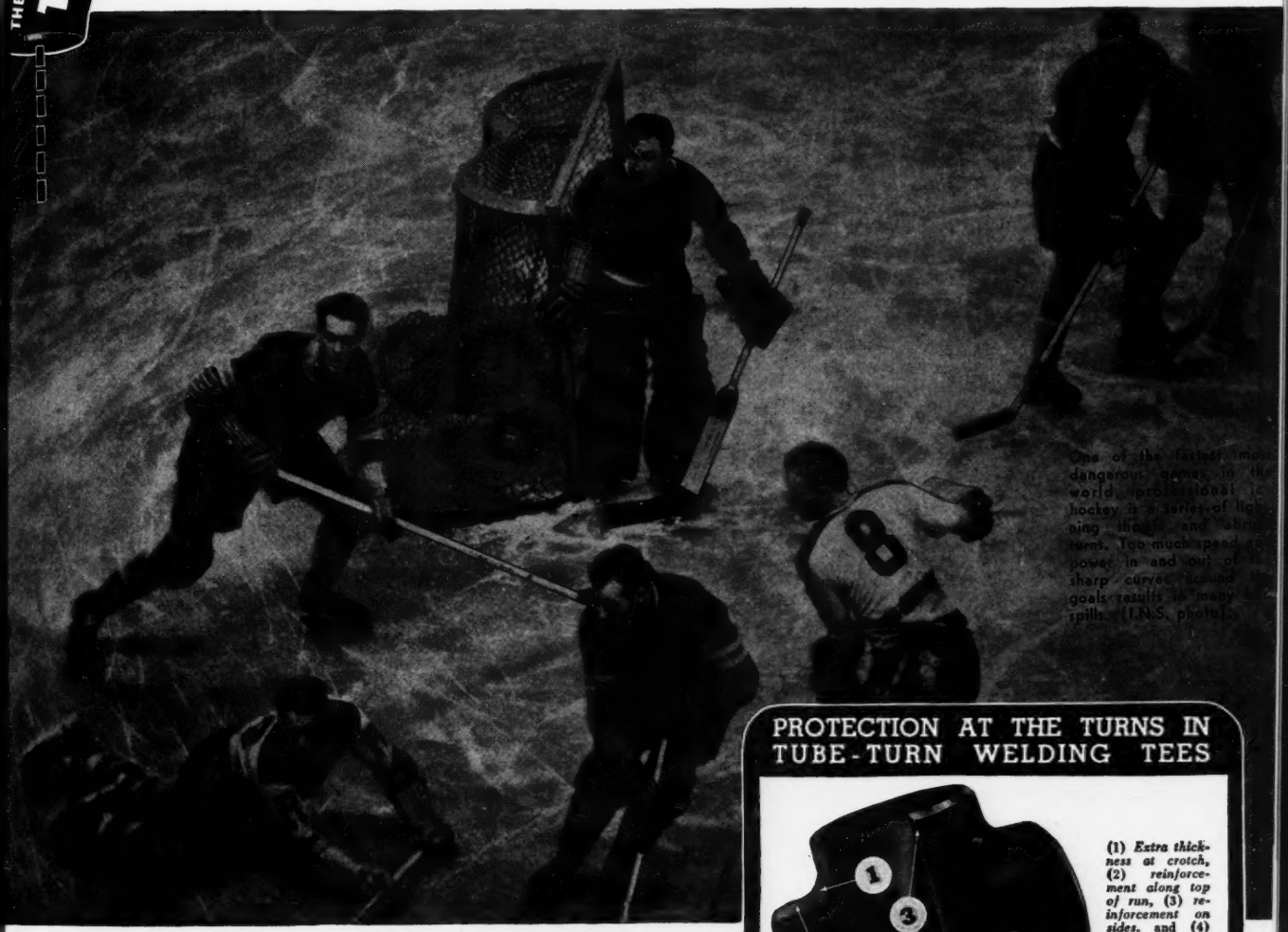
The huge training programs for defense workers, now in operation, must be "supervised with a view to training men for defense employment who are not liable for military service because of physical defects and age," the officer said.

More Aid for Textile Mills

AN AMENDMENT to Preference Rating Order P-53, issued December 3 by the Priorities Division, includes within the terms of the order the cones, tubes, and spools used in the operation of textile mills. The preference rating of A-10 may now be applied to the acquisition of the necessary materials by producers of these essentials.

THE DANGER LIES AT THE **TURNS**

---- LOOK OUT when force hits the turns in PIPING, too!



One of the fastest, most dangerous games in the world, professional ice hockey is a series of lightning thrusts and abrupt turns. Too much speed or power in and out of sharp curves around goals results in many a spill. (I.N.S. photo)

Welding with TUBE-TURN Fittings removes "Danger at the Turns" in Piping!

Abrupt turns and surging speed—the very things that cause most accidents in hockey—also account for major piping troubles.

Wherever there's *a change in flow direction,* look out for extra wear and strain. Be sure of trouble-free operation with Tube-Turn Welding Fittings. They are designed and manufactured *expressly* to protect piping systems at these vulnerable points.

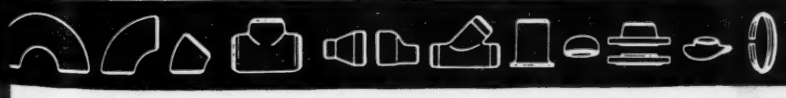
There are all types, sizes and weights of Tube-Turn welding fittings—elbows, returns, tees, reducers, laterals, nipples, and flanges. For *every* welding fitting need, specify Tube-Turn fittings *by name!*

Write for Tube-Turn engineering data book and catalog.

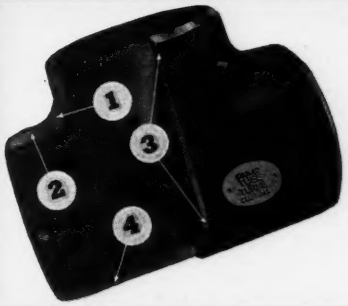
TUBE-TURNS, Inc., Louisville, Ky. *Branch offices:* New York, Philadelphia, Chicago, Pittsburgh, Cleveland, Tulsa, Los Angeles. *Distributors everywhere.*

TUBE-TURN *Welding Fittings*

TRADE-MARK



PROTECTION AT THE TURNS IN TUBE-TURN WELDING TEES



(1) *Extra thickness at crotch,* (2) *reinforcement along top of run,* (3) *reinforcement on sides,* and (4) *increased thickness at bottom* give extra strength to Tube-Turn tees at the points where stress and strain are greatest.

CROSS-SECTION OF TUBE-TURN ELBOW SHOWS SUPERIOR DESIGN

OUTER WALL NOT STRETCHED OR THINNED
SMOOTH INTERIOR WALLS NO WAVES OR RIDGES
WELDING RADIUS THROUGHOUT MINIMUM RESISTANCE TO FLOW
INSIDE WALL NOT THICKENED
CLEAN ACCURATE BEVEL

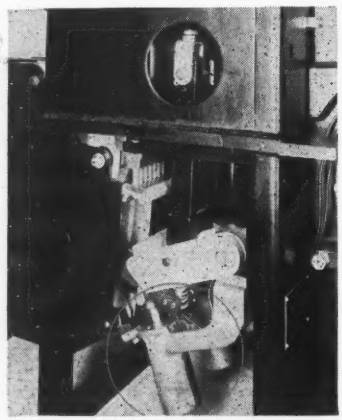
Here are vital engineering advantages that tell quickly why you get more with Tube-Turn welding elbows—*the elbow that made ALL Tube-Turn fittings famous.*

New Equipment

Information that you desire about any equipment will be gladly furnished without obligation. WRITE POWER PLANT ENGINEERING.

Circuit Breaker Booster

AN AIR BOOSTER in the General Electric Co. Magne Blast circuit breaker makes it capable of interrupting all currents up to full rated capacity in an overall breaker time of eight cycles or less. Without the booster the breakers can interrupt transformer and regulator magnetizing currents of 5 to 10 amp., but not without maintaining a fine, thread-like arc for some 30 to 60 cy.

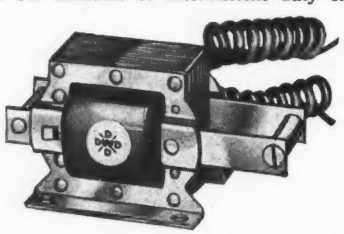


The booster which proved to be the solution to the problem of light current interruption consists of a small air dash pot attached to the stationary structural member of the breaker as shown. The loose-fitting piston member is held and driven by the opening blade into the cup extending from the lower arc chute connection. Entrapped air is forced up the hollow piston rod and directed to a small jet across the light current arc path.

As a result, maximum arcing time is reduced from a possible 60 to 4 cy. Thus, instead of a circuit interruption being delayed as a light current arc wanders slowly into the arc chute, any circuit is completely cleared within eight cycles, regardless of the value of current.

Laminated Solenoid

COMPACT design and sturdiness mark this new solenoid manufactured by Dean W. Davis & Co., Inc., Chicago, Ill. It is for constant or intermittent duty on



alternating current, and is furnished with either push or pull type plungers as illustrated, for control of valves and machinery.

Measuring 2 by 2 in. with a plunger stroke of ¾ in., this solenoid has a minimum push or pull of 5.5 lb. at full line voltage, and 3.75 lb. at 85 per cent of line voltage. It can be had for any voltage desired.

Lubrication System

LINCOLN Centro-Matic system of lubrication for industrial machinery was recently announced by Lincoln Engineering Co., St. Louis, Mo. It has a single pumping unit to draw from a reservoir or from original drums according to capacity required and arrangement desired. This unit supplies lubricant to a system of tubing or high-pressure hose from which an injector, adjusted for the amount of lubricant needed, delivers to each bearing. The injectors may be mounted singly or in manifold. Wide range of capacities and types of control are available as needed.

Arc Welder Control

IMPROVED and simplified design of its exclusive system of "Dual Continuous Control" for arc welding machines which eliminates the need for meters showing volts and amperes was recently announced by The Lincoln Electric Co., Cleveland, Ohio.

These welders have both job selector and current control calibrated and equipped with dials which indicate the type of work and the number of amperes for each and every setting. This feature enables the welding operator to vary both the slope of the volt-ampere curve and the amount of welding current independently and positively to suit every job encountered.

Another feature is that both voltage control (job selector) and current control are continuous in operation. Being continuous, the control can be advanced or retarded in increments as fine as desired.

Advantages of the new development, as emphasized by the manufacturer, include (1), ability to set and read the current from the dial; (2), elimination of trouble and expense resulting from meter breakage; (3), elimination of meter inaccuracy after a few months use in service in the field; (4), availability of positive polarity reversal; and, (5), ability to quickly verify polarity by noting position of switch handle.

Pistol Grip Caliper

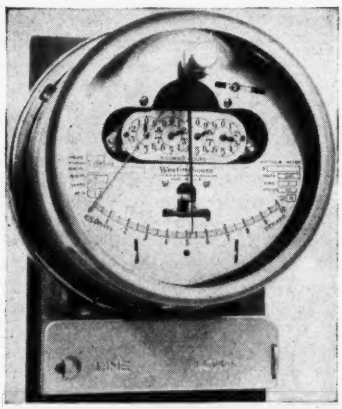
THIS NEW Pistol Grip Caliper being manufactured by the Airetool Mfg. Co., Springfield, O., is useful for calibrating tube ends after rolling, or checking for erosion and corrosion points. It is ex-

tremely handy to operate and is quite accurate. Calibration is effected by three points. Diameters from 2 to 6 in. can be secured with the same tool by using different sets of measuring points. The scale is direct reading and is marked off in 64ths of an inch.

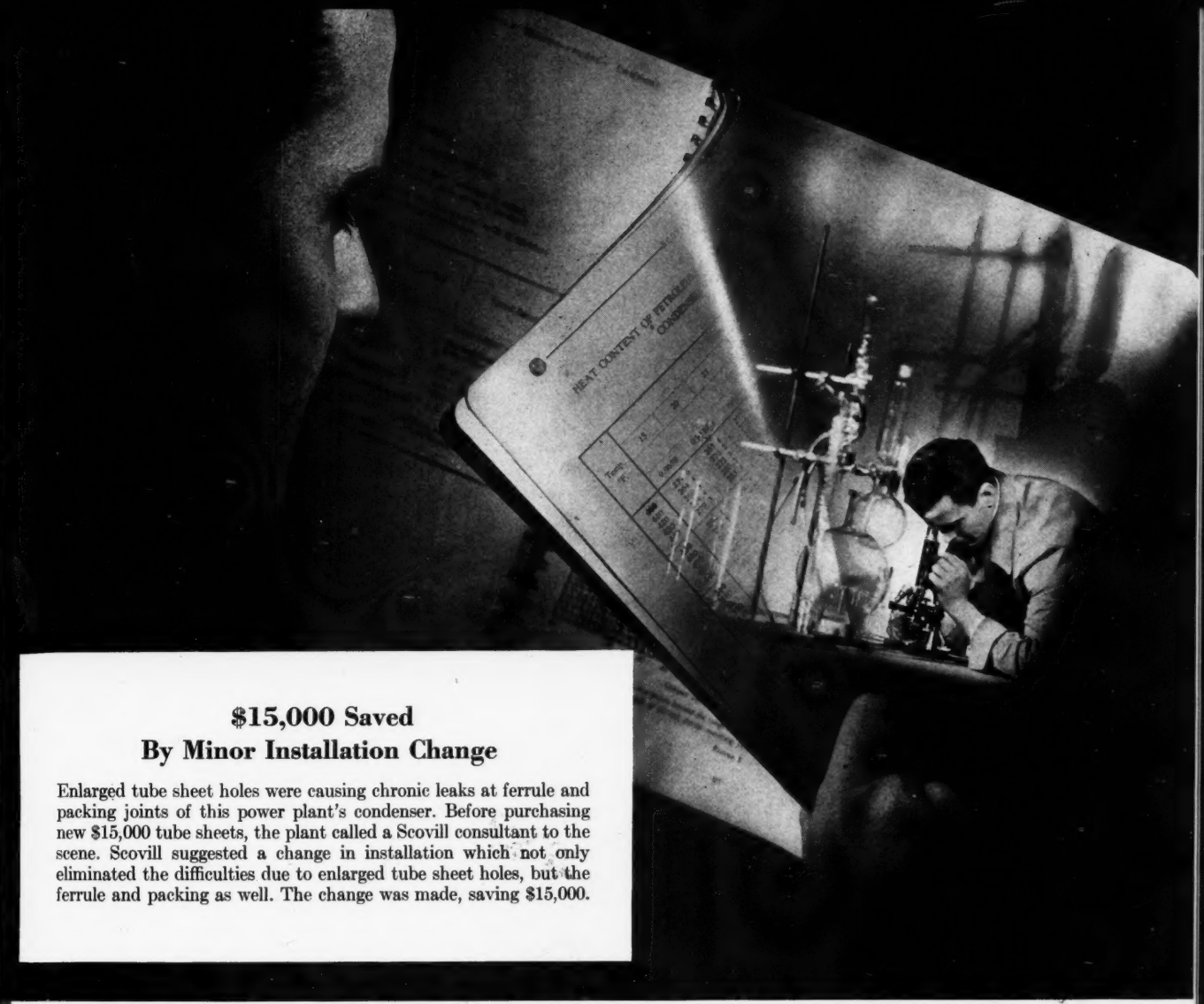
Thermal Demand Meter

ESPECIALLY developed to meet the continued extension of demand rates to smaller loads, a new low cost combination watthour and thermal demand meter —available for the first time in standard house size, case and mounting—is announced by Westinghouse Elec. & Mfg. Co. With a-c ratings of 5, 15, and 50 amp., 120 to 240 v., 2 and 3-wire for reading up to 20-kw., the unit is similar to the ordinary watthour meter in general appearance.

In eliminating the self-contained transformer used in previous thermal meters, the voltage component of the thermal element is fed by a secondary coil wound directly over the potential



coil of the watthour meter. This arrangement makes it possible to combine the watthour and thermal demand mechanisms into a single unit. An improved design of the thermal unit greatly reduces the required operating energy. Dial and nameplate are combined with the demand scale located at the bottom of the dial. Two demand pointers are provided; one operating as a pusher, and the other to indicate the maximum demand.



$15,000 Saved
By Minor Installation Change

Enlarged tube sheet holes were causing chronic leaks at ferrule and packing joints of this power plant's condenser. Before purchasing new $15,000 tube sheets, the plant called a Scovill consultant to the scene. Scovill suggested a change in installation which not only eliminated the difficulties due to enlarged tube sheet holes, but the ferrule and packing as well. The change was made, saving $15,000.

Use the laboratory behind the page

. . . To Make Scarce Metals Serve You Better and Longer

"At 210° F., recommend 70-30 Cupro-Nickel" . . . said Scovill's laboratory technicians, solving a complicated heat exchanger problem for a Scovill customer. You too may find that Scovill's laboratories can help you find the right tube for the job, or make the tubes you have stay on the job longer.

Scovill's new Heat Exchanger Tube Manual well illustrates the wide scope of Scovill's Service to Condenser Tube users. When any special problem in metal arises, whether it be the selection of materials to resist corrosion . . . or an expert analysis of your conditions of heat transfer or fluid flow . . . use *the laboratory behind the page* for time-and-money-saving results.

The new edition of the "Manual" includes charts, formulae, specifications and technical discussions — all on subjects of interest to those engineers and associates who are constantly needing unusual practical data to help them solve their heat exchanger and condenser tube problems.

Another publication — "Scovill Condenser Tubes" — is available to others whose heat exchanger tube problems are concerned with the more common problems of corrosion, material selection and methods of installation.

And yet these two publications represent only one of Scovill's three services for power, marine, and refinery engineers. Scovill's service in Manuals is supplemented by Scovill's field service in men, and Scovill's laboratory service in metals. Write to Scovill Manufacturing Co., 17 Mill Street, Waterbury, Connecticut.

SCOVILL
Masters of Metal

Scovill Condenser Tubes

ONE PRODUCT...THREE SERVICES

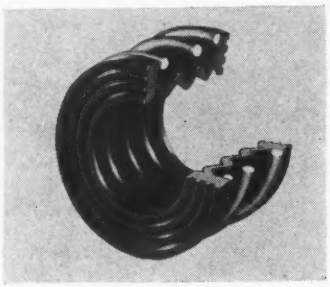
- **SERVICE IN MEN**
- **SERVICE IN METALS**
- **SERVICE IN MANUALS**

★ ★ ★ ★ ★ ★ ★

Scovill, for many years a regular source of supply for the U. S. Government, is cooperating in every way to forward defense plans. When deliveries are not as prompt as our customers desire, we hope they will realize that delays are sometimes unavoidable, and part of the price paid for National Defense.

Water Pump Seal

IN THIS bellows-type seal, manufactured by Crane Packing Co., Chicago, Ill., only two parts are used, the bellows of synthetic rubber to resist action of grease, oils, salt water, alcohols and anti-freeze; the spring, fixed in place against the inside shoulders of the flanged ends, to hold the contact facings against the sealing washer on one end and the driving base on the other end.

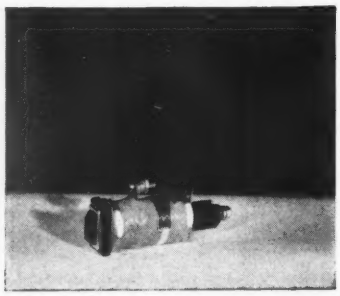


The entire unit, bellows and spring, is spring driven to operate as a driving coupling, with no sliding contact with the shaft so that rust and corrosion do not reduce effectiveness. Ability to flex and compress as a unit compensates for misalinement, fan thrust and impeller vibration. The seal is installed partially compressed, ready for instant duty and goes in either end to, with serrated contact facings at both ends.

Indicating Lamp

FOR GENERAL INDICATING or signal purposes on switchboards, control desks, and panel boards, a new indicating lamp is announced by Westinghouse Electric and Manufacturing Company.

Known as the Minalite, the lamp has a rectangular-shaped lens designed for extreme angular visibility. Receptacle is made of one-piece moulded material and is suitable for mounting on panels $\frac{1}{16}$ to 2 in. thick. Resistors as part of the unit are used for line voltage ratings between 50 and 250 v.



Pressure type leaf spring contacts establish connections with the slide base telephone lamp having a rating of .032-.038 amp., 24 v. The rectangular lens assembly is held in place by steel spring clips engaging in retaining grooves of the receptacle. A chromium metal holder encases the lens and spring clips. Terminals of standard 10-32 hardware are easily accessible in the rear.

Cleaning the Air Cleaner

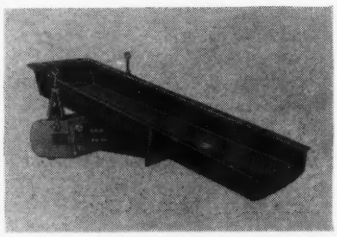
ELECTROSTATIC precipitators, widely used for air-cleaning problems in public buildings, have grown to very large sizes. In places where it must not be shut down a serious problem is to rid the mass of dirt it traps from the air. To solve this Westinghouse Elec. & Mfg. Co. has developed a new semi-automatic device to clean the Precipitron with a brief service interruption to only a small section at a time.

A hundred-cell array of Precipitrons is divided into five 20-cell sections. The cleaner is placed in front of one section which is disconnected from the ventilation system and from the power supply. The cleaner has a motor-driven carriage, that sweeps slowly up and down in front of the dirty precipitator plates, with three horizontal rows of nozzles from which water, air, and oil are sprayed in turn over the plates.

The cleaning operation stops automatically after 30 min. All the operator needs to do is to start it and a half hour later return and move it to the next section. Cleaning a 100-cell precipitator bank used to be a job for three men working for 8 hr.

Vibratory Feeders

TWO NEW models of electromagnetic Vibratory Feeder Conveyors have been placed on the market by the Syntron Co., Homer City, Pa. The Model F-4 illustrated here has a capacity of up to 100 t. per hr. of material such as crushed rock, and carries feeder pans as wide as 36 in. and as long as 60 in. in size. Model F-5 will handle as much as 500 tons per hr. of such material and can be supplied with troughs as wide as 48 in. and from 60 to 90 in. long.



These new models, like the smaller-capacity Syntron Feeders, are vibrated at high speed by a pulsating electromagnet. The principle of energizing these magnets through the medium of a rectifier tube accomplishes the heavy tonnage capacity.

One major advantage is the finger-tip rheostat control of the rate of flow, permitting a range of feeds from a rushing torrent down to a slow dribble.

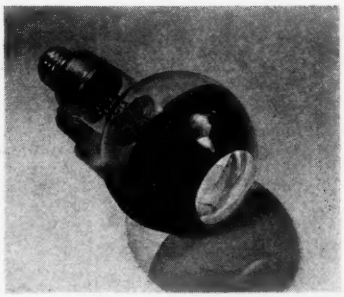
Another major feature of this equipment is the absence of such moving parts as gears, cams, screws, discs, rollers, idlers and connecting rods.

Infra-Red Tungsten Heat Lamp

A NEW TYPE of infra-red heat lamp developed in the Birdseye Research Laboratories of the Wabash Appliance Corp., Brooklyn, N. Y., has just been announced as the first commercial type of radiant heat lamp whose design and construction make possible and entirely practicable 100 per cent control of heating efficiency.

The new bulb is designed to put to practical use for heating what Wabash engineers term is the "spilled heat" lost in even the most efficient co-ordination of heat lamp and commercial reflector in use today. Wabash engineers point out that although the many efficient heating reflectors provide convergent, parallel or divergent heat beams as needed, there is still the average of 25 per cent of the heat rays that are spilled outside the control of any reflector and thereby lost.

The new "bullseye" type of Birdseye Heat Lamp is said to control these "spilled heat rays" and to put them to



work for heating even when present reflector equipment is utilized. The new bulb is distinguished by a ring lining of pure silver sealed inside the bulb at a point just below the focal point of the filament, as illustrated. This silver ring leaves a clear "bullseye" spot through which heat beams are projected fom the filament direct to the heating area without spill or loss. All remaining heat rays, including what were formerly spilled heat rays, are now gathered into the control area of the reflector by the silver ring lining, and projected down to the heating area.

The new "bullseye" lamp will be available in the 250 watt size, tungsten filament only, will fit the standard Edison screw socket, and will have an average burning life in excess of 5000 hr.

Lighting for Sabotage Protection

GLARE, the anathema of lighting engineers, is an ally in the present defense against the saboteur. Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa., lighting engineers are using it to blind a would-be intruder to a war-materials plant while the guards remain inconspicuous in the shadows, just as one can at

night see clearly into a lighted room but cannot be seen readily by those inside. A Fresnel lens, in reality a miniature lighthouse beacon, throws a flat, fan-shaped beam of light, with great efficiency. A row of these luminaires is set on posts several feet away from the buildings to be protected, aimed so their light is projected slightly downward away from the buildings. The space between the luminaire and the buildings is virtually in darkness. A would-be intruder approaching the plant sees only these blinding spots of light; guards behind the lights see him clearly.

ADDITIONAL SAFETY INSURANCE

FOR HIGH TEMPERATURE • HIGH PRESSURE PIPING

MIDWEST GLOBACK JOINTS

Called "Globack" because the back face of the lap is a segment of a globe or sphere, this high pressure pipe joint is a big improvement upon regular lapped (Van Stone) joints. Developed by Midwest, "Globack" Joints have these important advantages: (1) in critical area of lap, the metal thickness is much greater than pipe wall thickness, consequently the lap is stronger in shear; (2) distribution of bolting pressure is uniform, and fair seating of flanges is assured; (3) bending moment to which the lap is subjected is less because the maximum stress is removed from lap periphery and the resultant bolting force is shifted toward the pipe wall.

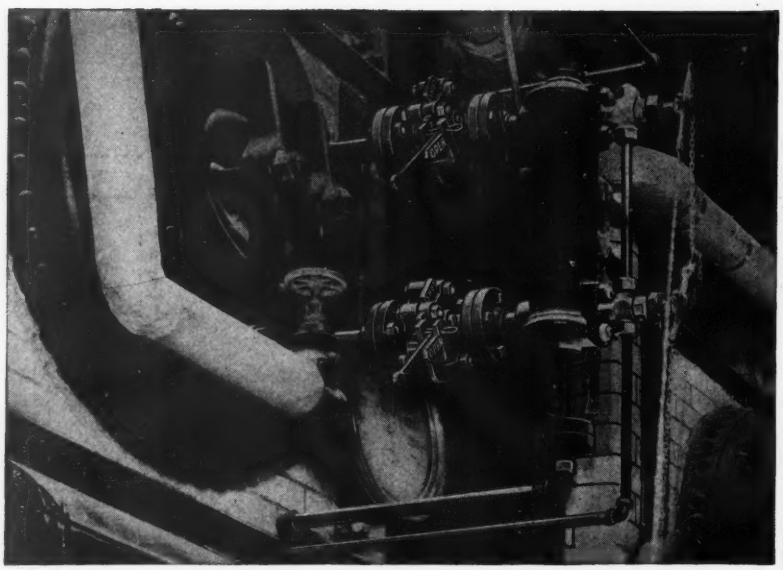
The Midwest "Globack" principle is also applied to other flanged joint facings: tongue-groove, male-female, etc. Let us tell you about some of the recent outstanding high pressure, high temperature central station piping installations that have Midwest "Globack" Joints.

MIDWEST "GLOBACK" (VAN STONE) LAP

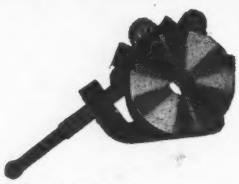
Dotted line indicates full pipe wall thickness (Van Stone) lap, and shows that Midwest "Globack" Joint provides maximum strength in critical lap section—where strength is most needed.

MIDWEST PIPING & SUPPLY CO., Inc., Main Office: 1450 S. Second St., St. Louis, Mo.

Plants: St. Louis, Passaic (N.J.) and Los Angeles • Sales Offices: Chicago—946 Marquette Building • Houston—229 Shell Building
Los Angeles—920 Anderson Street • New York—(Eastern Division) 30 Church Street • San Francisco—436 Call Building • Tulsa—833 Mayo Building



EVERLASTING
WATER COLUMN VALVES



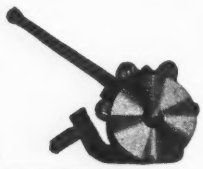
for dependability and safety

Meeting every provision of the A. S. M. E. Boiler Construction Code, and widely preferred by experienced engineers, the Everlasting Water Column Valve perfectly fills the requirements of this service.

These leak-proof valves permit the replacement of gauge glasses and trycocks in complete safety, without danger of the operator being scalded and without shutting down the boiler. In addition to the important features mentioned at the left, the arrangement of the valve is such that the weight of the operating parts tends to keep the valve in an open position.

Full particulars will be sent on request.

WHEN OPEN . . .
the Everlasting Water Column Valve provides a straight through unimpeded passageway. The fact that the valve is open is visible at a glance and a lock on the open indicator prevents accidental closing.



WHEN SHUT . . .
the record of the Everlasting Valve assures the operator of a leak-tight closure so that a new gauge glass can be installed without the necessity for protection of the operator's face and hands from escaping steam or water.

EVERLASTING VALVE COMPANY
Jersey City . . . . . New Jersey

Everlasting Valves

for everlasting protection

Soldering

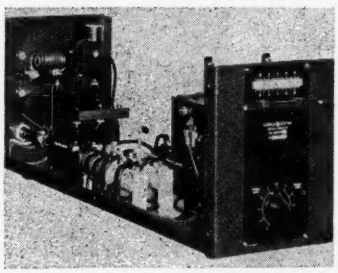
JIGGERS, a new product, manufactured by Jiggers, Inc., Chicago, Ill., should have instant appeal to all electrical service men. Each Jigger is a small, soldering unit that contains just the correct amount of 50-50 solder and flux hermetically sealed within a waterproof, heat-gener-

ating outer shell. To obtain a strong, perfectly soldered electrical connection, push the wire splice into a Jigger and touch a lighted match to the Jigger as shown. The shell ignites and produces the proper temperature to flow the solder into the splice. The burnt shell is then dropped off and a smooth, perfectly soldered splice is revealed.

Magnetic Oscilloscope

GENERAL ELECTRIC Co. has announced a new peak-reading portable instrument, the magnetic oscilloscope, developed primarily for use in resistance welding, but may be applied as a supplement to other instruments used in trouble-shooting and in making installation adjustment.

The oscilloscope has a high-speed response to both current and voltage, made possible by the use of a permanent-magnet type of oscillograph galvanometer. Magnitude, symmetry, and uniformity of current wave are revealed quickly by the length, position, and uni-



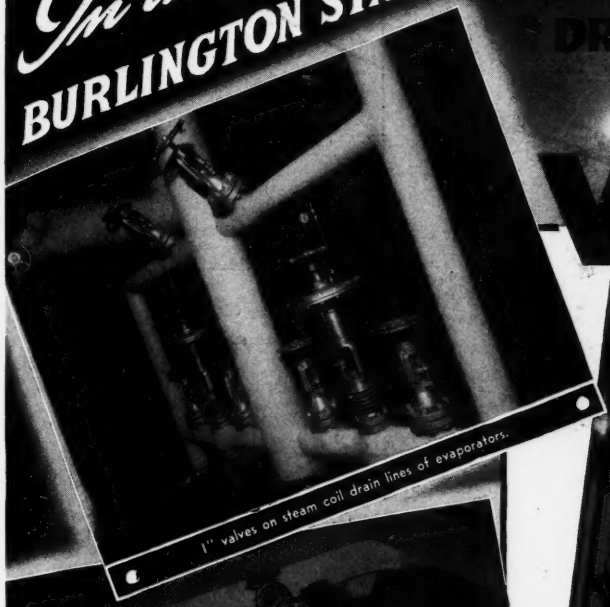
formity of a horizontal trace of light on the ground-glass viewing screen. A narrow light beam from an internal lamp impinges upon the tiny galvanometer mirror, the movements of which are reflected to the viewing screen. The instrument requires no reset time and a quick change from potential to current measurement is accomplished by turning a switch on the front of the box.

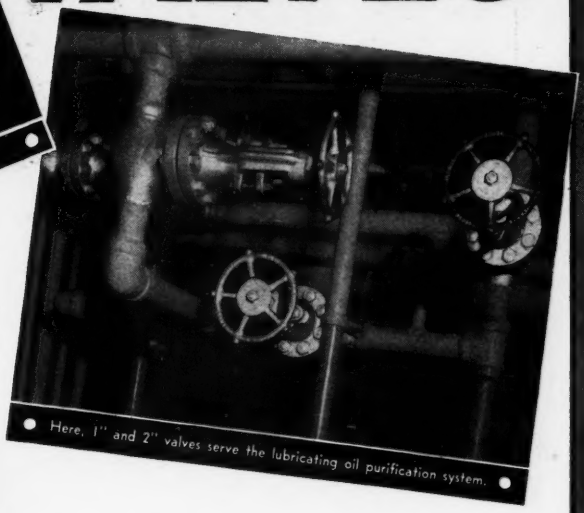
Electric Pipe Insulator

CORROSION and leak-resistant pipe insulators have been developed by the General Electric Co. for cable systems which require insulation between cable sheaths or joint casings and the oil supply reservoirs connected to joints and terminals. Small annular channels are provided in the plastic portion of the insulator. Into these are molded gaskets of C-1000 rubber. These rubber gaskets form a tight seal between the plastic and the brass of the inserts, thus effectively preventing the development of any leak because of differential expansion and contraction.

In the line at
BURLINGTON STATION

DROP FORGED STEEL
Steam
VALVES


1" valves on steam coil drain lines of evaporators.


Here, 1" and 2" valves serve the lubricating oil purification system.

1" valves on drains of main steam line to low pressure turbines.

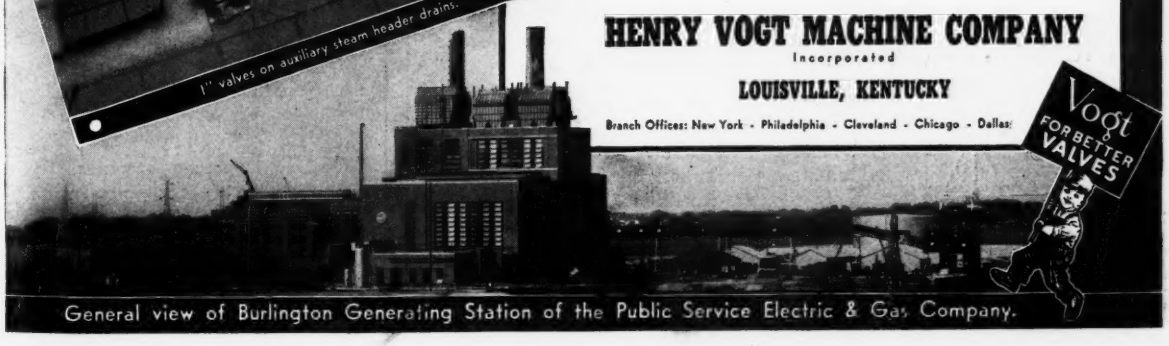
1" valves on auxiliary steam header drains.

Unit No. 5 at the Burlington Generating Station of the Public Service Electric and Gas Company has recently been placed in service. It consists of two 550,000 lb.-per-hour boilers which supply steam at 1,250 lb. and 950 deg. F., a 125,000-kw. condensing turbine-generator operating at 3,600 rpm., and the necessary auxiliary equipment.

Vogt *drop forged steel* socket weld end valves, as illustrated here, play an important part in the smooth, dependable functioning of this modern power plant.

Catalog F-8 sent upon request.

HENRY VOGT MACHINE COMPANY
Incorporated
LOUISVILLE, KENTUCKY
Branch Offices: New York - Philadelphia - Cleveland - Chicago - Dallas



General view of Burlington Generating Station of the Public Service Electric & Gas Company.

Below, a reproduction from an actual unretouched color photograph which illustrates the appearance of the gauge glass from directly in front.

I can see it from here

You can sit back and relax when you have installed PYREX Broad Red Line Gauge Glasses, because you can see the water level from one end of the boiler room to the other.

The transparent, broad red line fused directly to the wall of the gauge glass itself makes the water level stand out clearly and distinctly.

You can stop worrying about costs, too, for actual service records prove that PYREX brand Gauge Glasses last longer. Resistance to thermal shock protects them against sudden temperature changes. Machine drawn accuracy decreases installation strains. Transparency remains unimpaired by corrosive action of steam.

For serviceability with visibility, install PYREX Broad Red Line Gauge Glasses. Stocked by leading mill and steam supply dealers.

"PYREX" is a registered trade-mark and indicates manufacture by Corning Glass Works.

CORNING Glass Works Corning, New York

Pyrex Gauge Glasses

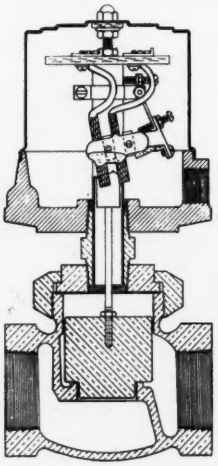
Looking Ahead . . .

In the power field, perhaps more than in other basic industrial fields, the continuous betterments in machinery and methods compel men to look ahead with broader vision and greater determination than ever before.

Reading the advertising messages that appear in POWER PLANT ENGINEERING will keep you informed on new trends and opportunities. Month after month, these advertisements describe what's new in generating, transmitting power. They will help you and your plant join the onward march of the power plant industry.

Flow Alarm Control

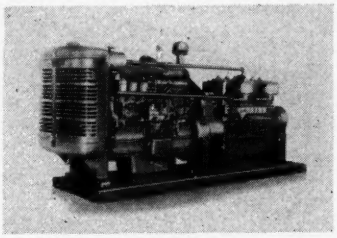
• FRED H. SCHAUB ENG. CO., Chicago, Ill., recently developed and added to their line of liquid level controls a flow alarm for water, oil, gas or air line service under either high or low pressure. The magnetic operating principle eliminates use of stuffing boxes of any kind and assures positive operation. The installation can be made at any place where an ordinary check valve will operate.



This Magnetrol Flow Alarm consists of a full ported globe valve body attached to a patented magnetic switching arrangement. The switch-head and valve piston assembly are attached to the valve body by a union bonnet nut making removal for inspection a simple operation. Units are available in a complete range of standard pipe sizes up to 4 in. and the electrical switch is rated at 15 amps., 125 v., or 10 amps., 250 v.

Compressor Unit

UNDER the trade name Engine Drive—In Line Compressor, Schramm, Inc., West Chester, Pa., has developed a new line of compressors built in sizes ranging from 120 to 600 cu. ft. displacement, these outfits are made available for those applications not reached by electric power service or where gasoline, oil, distillate or Diesel power units are preferred as a



driving medium. A number of standard assemblies have been provided in semi-portable and stationary types.

Mounted on a sturdy deck type base ready for immediate operation, these light, compact, easy-to-handle combinations are used with equal success for semi-permanent service on contracting or tunnel work, prospecting, mining, industrial use on short time, overtime, or night work where the demand for air is such that it is not economical to operate large compressors.

WeldELLS *alone*

have these precision quarter-marks

THOSE four little unobtrusive marks on the ends of WeldELLS often look mighty big to the man on the job. For they provide accurate reference points that make it a lot easier to establish center lines, figure angles and offsets, and keep piping lined up in the proper plane.

Yes, the quarter-marks on WeldELLS save time and trouble and prevent costly errors. In fact, they are so useful that many practical piping men will tell you this feature alone would make WeldELLS their first choice. But actually there are at least seven other good reasons why you should insist on WeldELLS.*

Quarter-marks are an *exclusive* WeldELL feature—a typical example of the extra value you get in all Taylor Forge Welding Fittings and Forged Steel Flanges. Ask your local distributor for a copy of Taylor Forge Catalog No. 401.

TAYLOR FORGE & PIPE WORKS

General Offices & Works: Chicago, P.O. Box 485
New York Office: 50 Church St.
Philadelphia Office: Broad Street Station Bldg.

WeldELLS have *everything

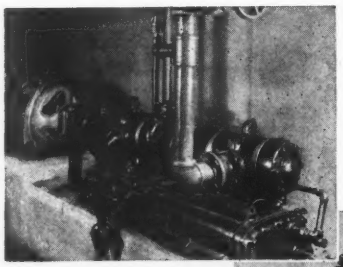
No other fittings for pipe welding combine these eight features. Besides quarter-marks (described here) the features are:

1. Seamless—greater strength and uniformity.
2. Tangents—keep weld away from zone of highest stress—simplify lining up.
3. Selective reinforcement—provides uniform strength.
4. Permanent and complete identification marking—saves time and errors in shop and field.
5. Wall thickness never less than specification minimum—assures full strength and long life.
6. Machine tool beveled ends—provides best welding surface and accurate bevel and land.
7. The most complete line of Welding Fittings and Forged Steel Flanges in the World—insures complete and undivided responsibility.

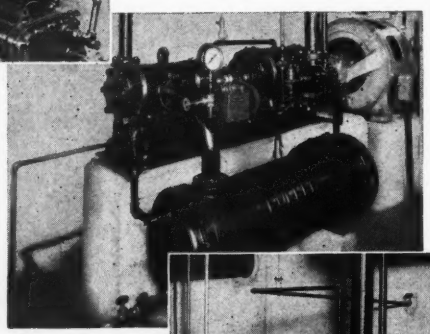
FULLER ROTARY

FOR HEAVY DUTY TO 125-LB. PRESSURE

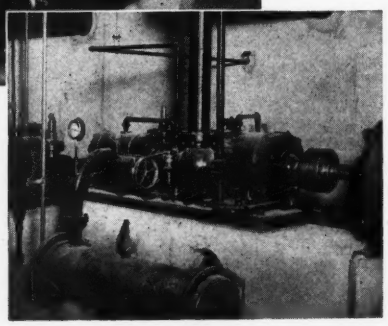
For Heavy-duty, Fuller Rotary Compressors demonstrate their worth . . . available for 80 to 125-lb. service.



Left: **234 C.F.M.** actual free-air delivery, **100-lb. pressure**, Two-stage Rotary Compressor, installed May, 1935, in an incinerator plant in Ohio. No repairs have been made on this machine since being installed. Three Fuller Rotaries are in use at this plant.



Center: **330 C.F.M.** actual free-air delivery, **100-lb. pressure**, Two-stage Rotary Compressor, installed February, 1936, in a foundry in Pennsylvania. This machine furnishes air for general plant duty. The records show expenditures of only $12.00 for repairs, to date. A pertinent factor to be considered when purchasing your next compressor.



Right: **470 C.F.M.** actual free-air delivery, **100-lb. pressure**, Two-stage Rotary Compressor, installed 1938, in a cement plant, for general plant duty. Three Fullers are installed in this plant.

Write for Bulletin C-3A

FULLER COMPANY
CATASAUQUA, PENNSYLVANIA

Chicago: 1118 Marquette Bldg.
San Francisco: 320-321 Chancery Bldg.

C-52

FULLER

PIONEERS OF HIGH-EFFICIENCY ROTARY COMPRESSORS

Automatic Car Spotter

A NEW AUTOMATIC car spotter by the Brown-Fayro Co., Johnstown, Pa., is designed for use where a single-belt conveyor serves a large number of working places, and where coal may be loaded into mine cars at rates as high as 6 t. per min. Using Westinghouse electric controls, a barney, attached to the endless rope, operates in guides set between the rails. Under the control of the operator and the limit switch, this barney is pulled forward exactly one car-length, then is automatically stopped and pulled back one car-length. On the forward motion the barney engages a lug on the car and pulls the entire trip with it, stopping an empty car exactly under the conveyor discharge.

Thus a constant supply of empty cars, placed at the loading point, permits the conveyor to pour out a continuous stream of coal without shutting down to change ropes. The car spotter is rated 12,000 lb. rope pull and is geared for a slow hauling speed of 40 ft. per min.; a fast hauling speed of 60 ft. per min.; and, a return speed of 80 ft. per min. The barney can be returned two car-lengths instead of one at the discretion of the operator. Quick starting and stopping is accomplished by means of automatic acceleration and dynamic braking.

MANUFACTURERS' PERSONALS

Announcement was recently made (p. 118 of the October 1941 issue) that G. C. Walker had been appointed Sales Manager for the Bird-Archer Co. of New York City. The announcement should have stated that Mr. Walker was appointed Eastern Industrial Sales Manager. The Bird-Archer Co. Western Industrial Sales Manager is E. A. Lowenthal and the Railroad Sales Manager, George H. Sill.

T. I. Phillips

T. I. Phillips

ELECTION of T. I. Phillips as a vice president of the Westinghouse Electric & Mfg. Company was announced after a recent board meeting by A. W. Robertson, Chairman. Mr. Phillips started with the Company as a tool maker in 1915 and has been assistant to the president of the Company since February 14 of this year. A native of London, Eng., Mr. Phillips was educated in public schools of Lynn, Mass., attended evening school and took a course of apprentice training to fit himself for the job of tool maker. He was soon made a foreman and in 1919 was transferred to East Pittsburgh for time study work in the railway department and the copper mill.

Mr. Phillips later became general foreman of the tool department, assistant chief inspector of the East Pittsburgh works and superintendent of the metal stampings department. In 1930, he was appointed manager of the works department at the Nuttall plant of the company and 3 yr. later was made works

LOOK OUT FOR RUST

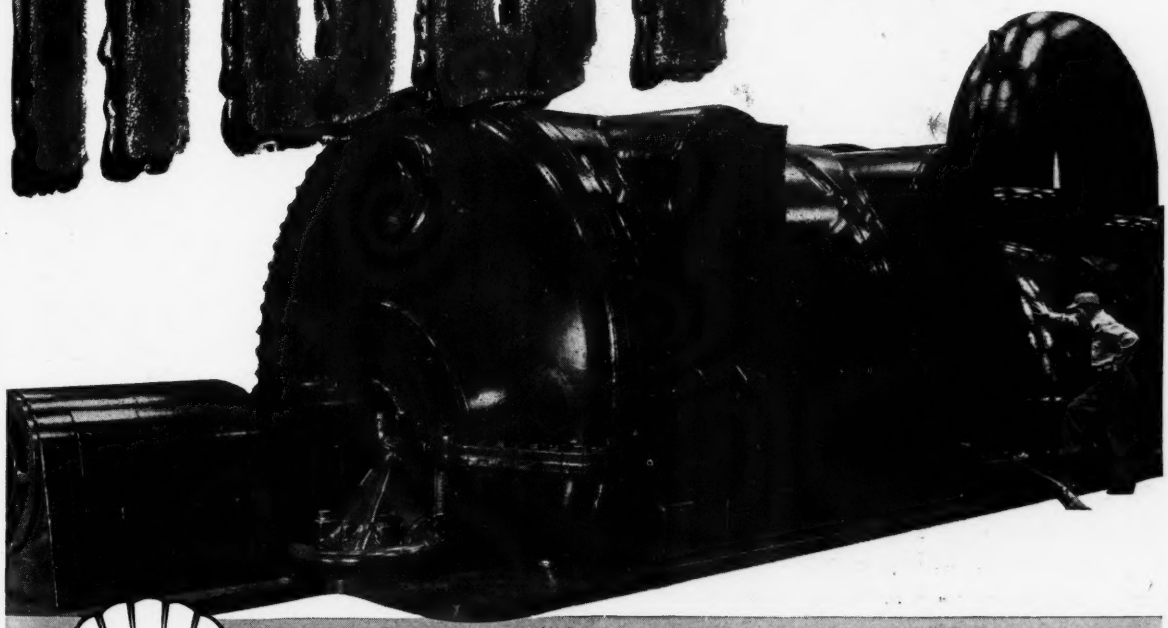
IT'S no news to you that rust can play havoc with turbines. A year ago there wasn't much you could do about it. Then came *new* Shell Turbo Oil. Now a field-tested, service-proved turbine oil that has made history . . . the first to meet all 3 vital needs of modern turbine lubrication . . .

RUST PREVENTION

SUPERIOR OXIDATION STABILITY

MINIMUM FOAMING TENDENCY

Why accept less?
Call in Shell today.

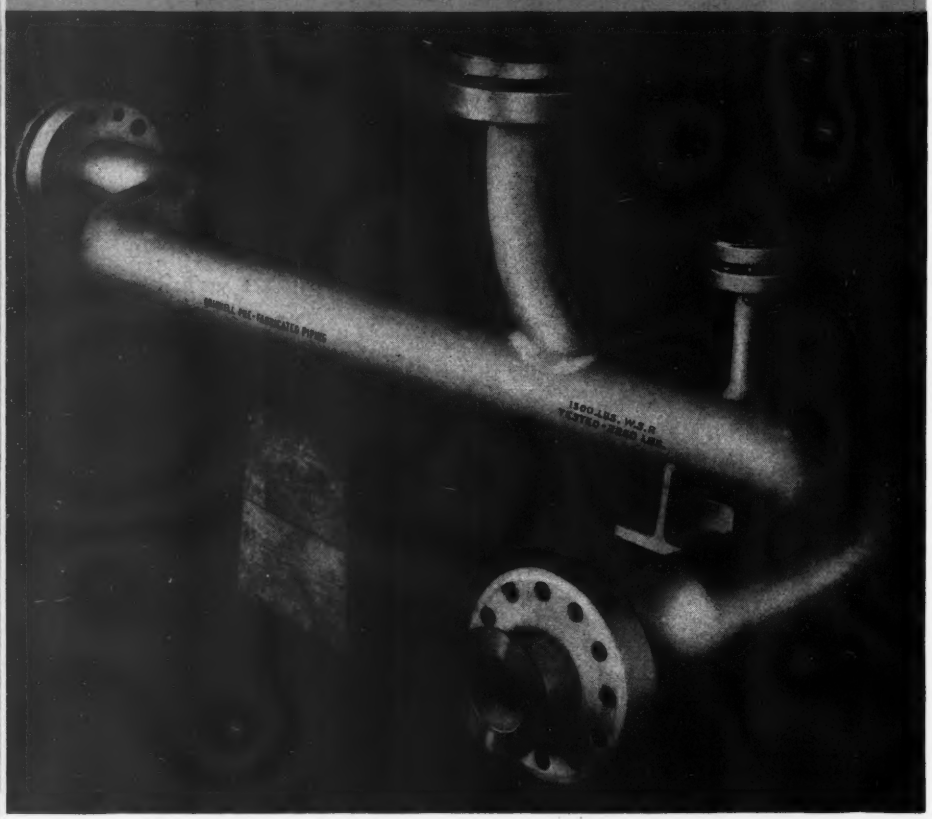


SHELL

Protect YOUR turbines with

SHELL TURBO OIL

HOW TO *Sub-Contract* YOUR PIPING PROBLEMS!



WHEN defense orders necessitate added power piping in your plant, take this short-cut through the special engineering and prefabrication problems that precede installation. "Give the plans to Grinnell", and you'll "sub-contract" all the troubles of interpreting super-pressure steam requirements into super-power piping.

Grinnell engineers are power specialists, qualified by long experience to interpret even the most complex power problems into speedily-erected, underwriter-approved piping systems. Grinnell plants, strategically located to serve defense industries, are equipped with every last facility to prefabricate these systems.

Grinnell is helping leading manufacturers, utilities and process plants to meet defense needs for added power. Write for Data Book, "Grinnell Prefabricated Piping". Grinnell Company, Inc., Executive Offices, Providence, Rhode Island. Branch Offices in principal cities of the United States and Canada.

GRINNELL

WHENEVER **PIPING** IS INVOLVED

manager for the company, to serve as control authority for all manufacturing operation. His appointment as assistant to the president, in charge of a headquarters manufacturing staff and supervision of several important divisions of the company, was made last February.

Appointment of Robert J. Howison as Sales Manager of the Automotive Division, Morse Chain Co., Detroit, is announced by Frank M. Hawley, vice-president. Mr. Howison has had more than 20 yr. association in the silent and roller chain industry, on application of timing chains for internal combustion engines, as well as general industrial work.

Promotion of Mr. E. R. Goss to Branch Manager of its El Paso, Tex., branch office has been announced by H. A. Jackson, president of Chicago Pneumatic Tool Co. Mr. Goss succeeds E. J. Coughlin, former branch manager, who was killed in an automobile accident. Mr. Goss started with the Chicago Pneumatic Tool Co. as a salesman in 1929 at its El Paso office, was transferred to the Los Angeles branch office in 1933 and returned to the El Paso branch again in 1937, being located at Phoenix, Ariz., until the present time.

Charles G. Wallis has been named works manager of the Westinghouse Electric Elevator Co., Jersey City, N. J., succeeding Ellis L. Spray, who was recently appointed manager of a new company plant near Philadelphia. Mr. Wallis joined the Elevator Company in 1928 and has served at various times as a design engineer, chief inspector and general foreman. For the past year he has been general foreman of the Jersey City plant. Born in Rocky Ford, Colo., in 1899, Mr. Wallis is an engineering graduate of Colorado State College.

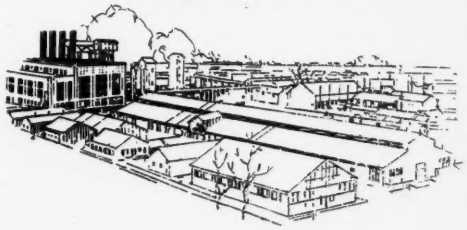
Charles W. Harbeck, fired by Thomas A. Edison 50 yr. ago when Edison operated the Edison Machine Works, forerunner to General Electric Co., today is among the few who hold the coveted diamond-studded half-century pin. Harbeck was fired two days after he was hired because Edison did not think he was over 14 yr. of age. Harbeck says he got back on the payroll a day or two later when he produced "papers from home, showing him of age." He is still employed by General Electric as a machinist.

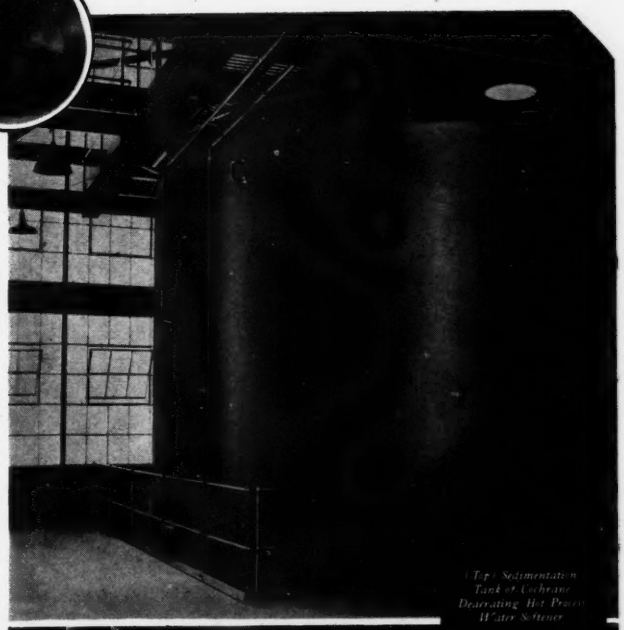
Chemical Company Retains Dr. C. E. Lucke

CHEMICAL CONSTRUCTION CORP., 30 Rockefeller Plaza, New York City, announces the appointment of Dr. Charles E. Lucke as consultant in their extensive work for the defense program. Dr. Lucke, who retired this year from his long-held post as head of the Department of Mechanical Engineering at Columbia University, is widely known as one of the country's outstanding authorities on heat and power. During World War I, he served as a Commander of the U.S.N. R.F., and later held important advisory positions with prominent industrial concerns, including Worthington Pump & Mach. Corp. and The Babcock & Wilcox Co.

WATER CONDITIONING at Radford ORDNANCE WORKS

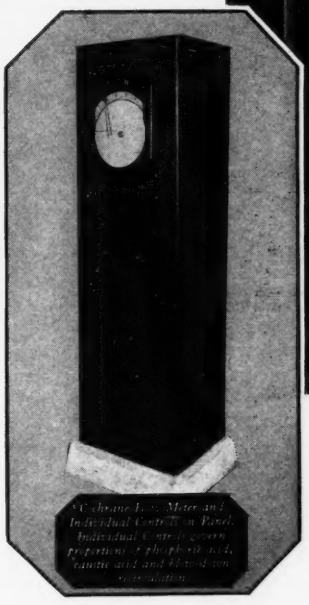
RADFORD, VIRGINIA





(Top) Sedimentation Tank of Cochrane Deaerating Hot Process Water Softener

(Below) Three Cochrane Filters in the Radford Power House



Cochrane Flow Meter and Individual Control Panel. Individual Controls govern proportions of phosphoric acid, caustic soda and magnesium salts solution

THE Radford Ordnance Works, producing smokeless powder, is part of the great network of munitions plants constructed for the War Department. Designed and operated by Hercules Powder Company, the power plant is supplied by four giant steam generators supplied with feed water of "zero" hardness and "zero" oxygen by a Cochrane Deaerating Hot Process Softener.

Feedwater is first treated with phosphoric acid, subsequently deaerated, and then—with the addition of caustic soda and magnesium salts—the hardness is reduced to zero. Silica is reduced to less than one part per million. Operating results have indicated no sludge accumulations either in the boilers or in the steam washers with which the boilers are equipped.

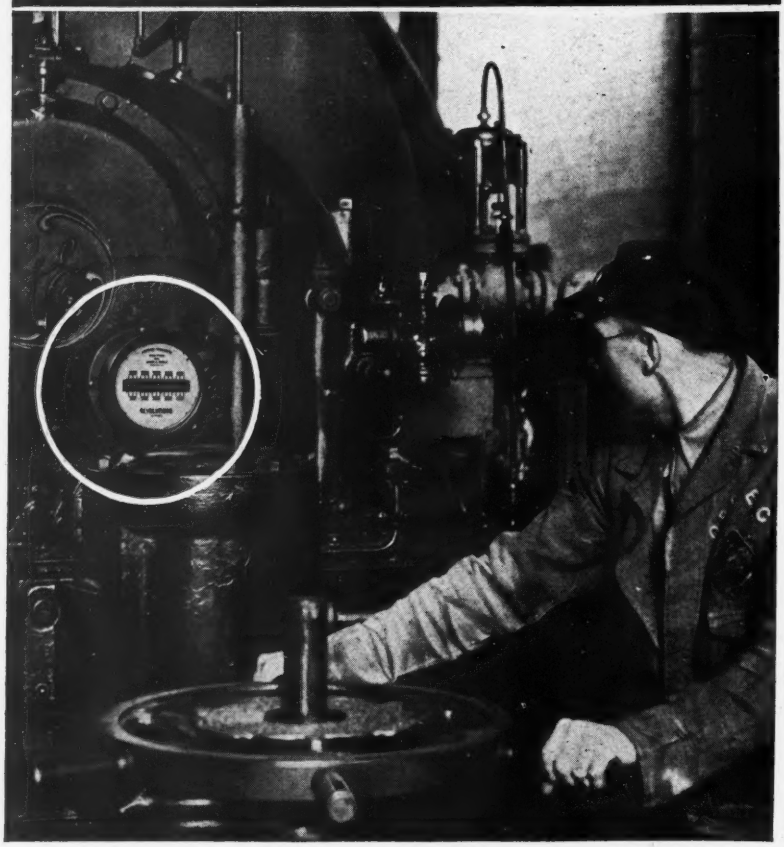
Chemical proportioners are electrically operated by a Cochrane Flow Meter, with individual feeds for individual chemicals so that adjustment of the chemical feeds for varying raw water conditions can be made by the turn of a knob.

Cochrane Corporation

3123 N. 17TH STREET PHILADELPHIA, PA.

WATER SOFTENERS • DEAERATING HEATERS • FILTERS • BLOW-DOWN EQUIPMENT • VALVES • FLOW METERS

"FRAHM" TACHOMETERS



A Tachometer that requires no maintenance and does not wear out!

A "Frahm" Vibrating-Reed Tachometer does not even have to be oiled because it contains no gears, bearings, rotating or any other wearing parts,—nothing to wear out. There is no electrical system—merely a set of accurately tuned steel reeds which vibrate by resonance according to the speed at which the machine is running. Simply mount the Tachometer in almost any convenient location; the slight vibration in the machine when running does the rest.

For more than 30 years we have supplied these unique speed indicating devices for use on turbines, generators, motors, centrifugal pumps and blowers. Ranges are available from as low as 900 up to 15,000 r.p.m.

More recently our hand type of "Frahm" Tachometer is being used for general speed-measuring work, and also for measuring rates of vibration, such as in pneumatic hammers and drills and in airplanes.

Write for illustrated descriptive Bulletin 1590-PE.

CENTRIFUGAL and CHRONOMETRIC TACHOMETERS

We also supply an attractive line of Indicating Hand Tachometers, Speed Indicators, Tachoscopes and Tachographs. Ask for *Bulletin 1505-PE*.

James G. Biddle Co.

1211-13 ARCH STREET *Electrical and Scientific Instruments* PHILADELPHIA, PA.

In his new association, Dr. Lucke will act as consultant in the selection and installation of power generating and mechanical equipment for the large projects on which the Corporation is engaged. He will maintain his connection with Columbia University as Stevens Professor-Emeritus of Mechanical Engineering.

Havery L. Williams, Jr., recently joined the Hawkins-Hamilton Co., Richmond, Va., as a sales engineer. Mr. Williams, a graduate of Washington and Lee University, has for the past 10 yr. been associated with A. M. Gathright & Co. in air conditioning work. His current responsibilities with the Hawkins-Hamilton Co., include sales engineering work in the Richmond territory for Cochrane Corp., Hays Corp., Nash Engineering, Northern Equipment, Terry Steam Turbine, Andale Co., Detroit Stoker Co., Micro-Westco, and Crosby Gauge & Valve.

Jesse H. Lide

Jesse H. Lide

JESSE H. LIDE has been appointed assistant general advertising manager of the Westinghouse Elec. & Mfg. Co., G. E. Pendray, assistant to the president, announced. His headquarters will be in the company's Pittsburgh office. Since 1940 Mr. Lide has been assistant advertising manager of the Westinghouse merchandising division in Mansfield, Ohio. He went to that position in 1940 from Philadelphia, where he was merchandise sales promotion manager of the Middle Atlantic District.

Born in Corinth, Miss., on September 27, 1902, Mr. Lide attended Mississippi State College and joined Westinghouse in 1924 following his graduation. He left the company in 1929 to become advertising manager of the Rome Wire Co., and later general advertising manager of the General Cable Corp. but rejoined Westinghouse in 1931.

New Advertising Manager

PROMOTION of Joseph A. Sullivan, assistant publicity manager of the Chicago Pneumatic Tool Co., to advertising manager was announced by Leslie S. Gillett, sales development manager. Joining the Chicago Pneumatic organization in 1928, Mr. Sullivan served until 1932 as head of the direct-mail division of the company's publicity department. From 1932 until 1935, he was with Sweet's Catalog Service as copy chief, but in 1935 rejoined Chicago Pneumatic as assistant publicity manager, responsible for the creation and production of all sales literature pertaining to the company's diversified line of products.

Due to the greatly widened scope of its activities, Chicago Pneumatic's Publicity Department was recently reorganized as the Sales Promotion and Advertising Department under the direction of Mr. Gillett, to whom Mr. Sullivan will report. Previous to his association with Chicago Pneumatic, Mr. Sullivan was assistant advertising manager of Columbia Phonograph Corp. and copywriter for the Biow Co., advertising agents.

2 YEARS WITHOUT AN OIL CHANGE

IN CIRCULATING SYSTEM

● EACH OIL CHANGE in the circulating system of the hydro-electric turbine in a Michigan plant required 70 gallons of oil. But the cost of oil was not the only reason the plant superintendent wanted to avoid frequent oil changes. Labor for cleaning the system was costly. Shutdowns were not only inconvenient, but expensive.

When a certain oil which he tried lasted only 6 weeks before it needed replacing, he welcomed the suggestion of a Standard Lubrication Engineer that he try a fill of Stanoil—an oil developed particularly for circulating system lubrication.

Now, after two years of operation in this system, Stanoil shows no sign of deterioration and little change in color. The saving in labor, oil costs, and shutdown time has *more* than paid for the difference in cost of this higher quality oil.

There are a number of grades of Stanoil. One of them may be just the oil you are looking for to save maintenance time and expense on reduction gear units, ring-oiled motor bearings, circulating systems, etc. A Standard Oil Engineer will tell you what grade you need for the job.

Write Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago, Illinois, for the Engineer nearest you. Say you want to try Stanoil.

Copr. 1942, Standard Oil Company (Indiana)

STANOIL

1. High Viscosity Index. 2. Low Pour Point. 3. Unusually High Stability. 4. Excellent Demulsibility. 5 Low Carbon-Forming Tendencies.

STANDARD OIL COMPANY (INDIANA)

LUBRICATION ENGINEERING...LUBRICATION ENGINEERING...LUBRICATION ENGINEERING...LUBRICATION

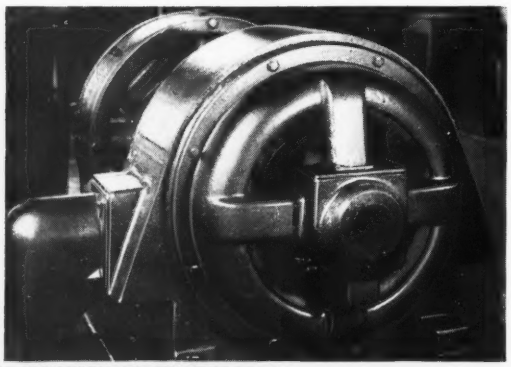
••LUBRICATION ENGINEERING••LUBRICATION ENGINEERING••LUBRICATION ENGINEERING••LUBRICATIO

SUPERLA GREASE REDUCES LOAD ON CONVEYOR DRIVE

Two problems complicated the lubrication of material-handling conveyors pictured here. Greases light enough to reduce starting torque, even in mildly cold weather, were quickly consumed or lost when the idlers reached normal operating temperatures. Heavier greases made starting difficult and power consumption high. Medium grade conventional type greases did not solve the problem. Was there *any* lubricant that would do the job?

A Standard Lubrication Engineer had the answer—Superla Grease. At the first trial *both* starting and consumption problems were solved, because of Superla's uniform rate of feed at all temperatures encountered.

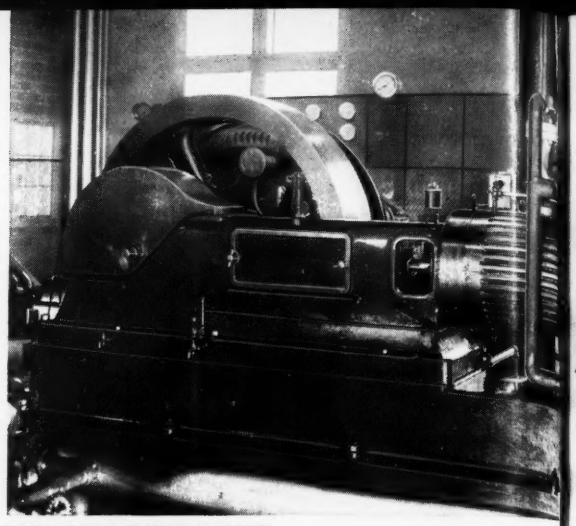
You'll find that Superla Grease will handle lubricating jobs for which you'd ordinarily buy a special premium-priced product. Have a Standard Engineer test Superla on some of your grease-lubricated bearings.



STANOIL PROTECTS GENERATOR BEARINGS AGAINST HEAT

Lack of space in an engine room made it necessary to mount a motor-generator on a balcony—the hottest spot in the room. The set operated continuously, which further increased bearing temperatures. To keep the bearings cool, the plant operator kept a fan blowing on the unit.

Then a Standard Lubrication Engineer told him about Stanoil. With Stanoil on the set the operator finds he can forget about both the fan and his bearing temperature troubles. Stanoil gives adequate lubrication even at high temperatures, because it does not thin out excessively.



STANDARD STEAM CYLINDER OILS ELIMINATE VALVE GROANING... CUT OIL CONSUMPTION 35%

Noisy slide valves in his two steam engines had the plant engineer at a Minnesota college worried. He knew that oil consumption on these engines was high enough to give more than adequate lubrication. He decided that it must be the fault of the oil he was using.

It didn't take long to find out he was right when he and a Standard Lubrication Engineer started analyzing his problem. First, they found that the oil wasn't atomizing properly. That trouble was cleared up when the right type of cylinder oil, which the Engineer recommended, was used. Valve groaning also disappeared. But the Engineer didn't stop there. He found that oil was being carried over into the heating system. So feeds were gradually reduced. Finally, consumption was cut 35%, yet the valves were adequately lubricated because of the high quality of the oil. Oil carryover thus was reduced to a minimum.

See if one of these Engineers hasn't a few suggestions that may be profitable to you.

HERE'S ALL YOU NEED TO DO TO GET STANDARD LUBRICATION ENGINEERING SERVICE

If your plant is located in the Middle West, you are free to call in the Standard Lubrication Engineer for advice and help on any lubricating problem. Right now, when your time is at a premium, is a good time to meet this Engineer. His suggestions may save a lot of experimenting and maintenance time where lubrication is concerned. You can reach him by calling the local Standard Oil Company (Indiana) office, or writing 910 South Michigan Avenue, Chicago, Illinois. In Nebraska, write the Standard Oil Company of Nebraska at Omaha.

COLORADO
Denver

ILLINOIS
Chicago
Decatur
Joliet
Peoria
Quincy

INDIANA
Evansville
Indianapolis
South Bend

IOWA
Davenport
Des Moines
Mason City

KANSAS
Wichita

MICHIGAN
Detroit
Grand Rapids
Saginaw

MINNESOTA
Duluth
Mankato
Minneapolis

MISSOURI
Kansas City
St. Louis
St. Joseph

MONTANA
Billings

NORTH DAKOTA
Fargo

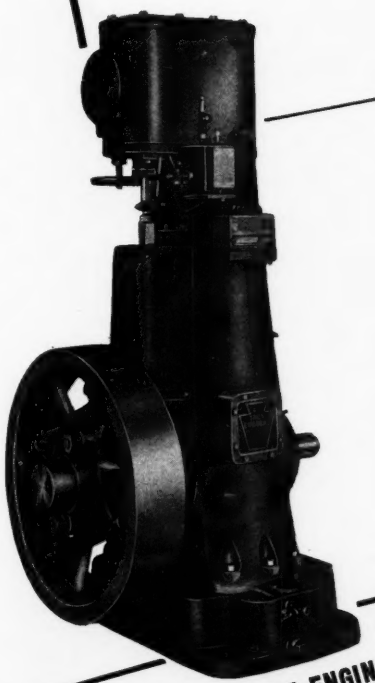
SOUTH DAKOTA
Huron

WISCONSIN
Green Bay
La Crosse
Milwaukee

WYOMING
Cheyenne

POWER COST... rather than TIME

MEASURES THE "UP-TO-DATENESS" OF THE EQUIPMENT DRIVE



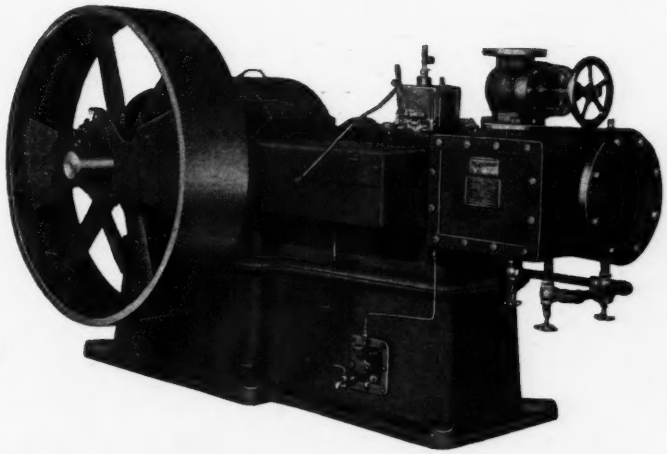
A HALF cent per kw.h. over-all power cost is as modern as anything . . . and it's the power cost and drive characteristics which determine whether or not a drive is modern!

Hundreds of Troy-Engberg Steam Engines are operating at around ½ cent per kw.h. for ALL costs; some higher, some lower. They are driving all sorts of equipment both in the power plant proper and out in the factory hooked up to production equipment. Such low power cost certainly stamps the drive as being modern.

Yes, the steam engine as designed and built today by Troy-Engberg is modern in every sense of the word and offers very desirable drive characteristics.

TROY-ENGBERG STEAM ENGINES
are widely used for
driving such equipment as

Fans
Blowers
Cookers
Compressors
Exhausters
Agitators
Pumps
Stokers
Dryers
Generators
Core Drills
Nitrators
Machine Shop Equipment



TROY ENGINE & MACHINE CO.

840 Railroad Ave., Troy, Pa.
Established 1870

1—TEM—2

Here's why we say for '42..

"On with the Old"

NOW, at the beginning of a new year in which the conservation of metals will be of the utmost importance for National Defense, we repeat something that we have been saying for many years: *Dart Unions pay greater dividends on your investment because they can be re-installed again, again and again.*

We suggest, therefore, that if there are any used Darts in storerooms or anywhere else around your plant, they be put back on the job. *They are still good . . .* and capable of the same tightness they provided the first time they were used.

How is this possible? Look at the illustration above. It shows the two famous Dart extra-wide bronze matched seats, ground to true-ball surfaces, a key reason for a Dart's unusual performance and long life. *Another* important reason is the fact that Dart bodies and nuts are made of air refined malleable iron that resists pipe strains, abuse, rust.

So—in behalf of metal conservation—*on* with the old Dart Unions. If you need *new* ones, get in touch with your local supplier. It always pays to remember, "Dart Unions can be used again, again, and again."

DART UNIONS

E. M. DART MFG. CO., Providence, R. I.

Sales Agents: The Fairbanks Company, New York, and all branches
Canadian Factory: Dart Union Company, Ltd., Toronto, Canada

MANUFACTURERS' NEWS

Hahn Engineering Co., 30 Church St., New York, N. Y., has become the Hahn Engineering Division of the Luria Steel & Trading Corp., with main office in the Woolworth Building, New York, N. Y. Eugene Hahn will direct the activities of the new division.

A new asbestos mill for utilizing Arizona asbestos fiber is under construction at Chrysolite, Ariz., by Johns-Manville Products Corp. Heretofore this fiber has been workable only as a marginal operation, but development of a special milling process makes possible the new plant, which will be in operation, employing some 100 men, early in 1942.

Allen Billmyre Corp. announces that they have moved into their new plant and their new address is now 431 Fayette Ave., Mamaroneck, N. Y.

Universal Fabricated Products Co. has been formed at 310 S. Michigan Ave., Chicago, Ill., by D. D. Grassick and will represent Alfol Insulating Co., Inc. of New York, N. Y., and Reynolds Metals Co. of Richmond, Va.

Permutit Co. of Canada, Ltd., a subsidiary of The Permutit Co. of New York, recently appointed S. A. Williams, Ltd., 60 Front St. W., Toronto, as its representative in the Province of Ontario, Canada.

E. F. Houghton & Co. of Philadelphia, has recently completed a new office building which is a 3-story structure, combining all modern features including glass-block construction and air conditioning. It is located at Third, Orianna and Lehigh Avenue, adjoining the company's plant.

In the extension of its bomber production facilities at Long Beach, Cal., (see p. 45) Douglas Aircraft Co. has just awarded a contract for 26 separate air conditioning systems to York Ice Mach. Corp. The new windowless building is similar in construction with a series of bays, each air conditioned by a separate unit, so arranged that damage to any portion of the plant will not affect the operations in adjoining sections. The air conditioning equipment is located on platforms suspended from the roof trusses.

To Help Stop the Japs

PEARL HARBOR NAVY dry dock in Hawaii will have four 54-in. pumps each with capacity of 130,000 g.p.m. against 20 ft. heads, a total of 520,000 g.p.m., sufficient to furnish Detroit with its water supply. These vertical shaft pumps are set 60 ft. underground, run at 277 r.p.m. and are driven by 1250-hp. motors. Equipment, all being furnished by Morris Machine Works, and will also include: two 12-in. drainage pumps for 7200 g.p.m. at 88 ft. head; an 8-in. pump for 3000 g.p.m. at 60 ft. head; two 3-in. sump pumps for 200 g.p.m. at 75 ft. head; two 4-in. swage pumps for 400 g.p.m. at 75 ft. had; a 4-in. like pump for 300 g.p.m. at 50 ft. head.

Ready Now! TO HELP YOU AVOID PLANT INTERRUPTIONS . . .

CRANE SHOP BULLETIN NO. 4
TIPS ON VALVE TRIM
TO HELP KEEP PIPING ON THE JOB
PLEASE CHECK AND PASS ON
POST ON SHOP BULLETIN BOARD
IT'S THE TRIM THAT COUNTS!
DISC
STEM
BODY SEAT RINGS
AN AID TO DEFENSE . . . No. 4 of a series of Shop Bulletins on how to get better service from piping equipment in today's emergency. Issued for maintenance men by Crane Co.; distributed free by Crane Representatives.
HELPFUL HINTS ON CHOOSING VALVES FOR BETTER PIPING SERVICE

UNDER war time production burdens, the danger of piping failures is greatly increased. One way to stop them is by making sure valves are trimmed right for the service they're in. Crane Shop Bulletin No. 4, with its handy guide, shows the right trim for most valve applications in your plant.

Crane Shop Bulletins are aimed to give you better service from piping equipment now when replacements aren't so plentiful. Designed for your maintenance crews—they help train new men, also keep veterans "brushed-up" on good piping practice.

Plants everywhere use these Bulletins in shops and employee training schools. In the hands of your men, they'll also help stop piping troubles and production line shutdowns.

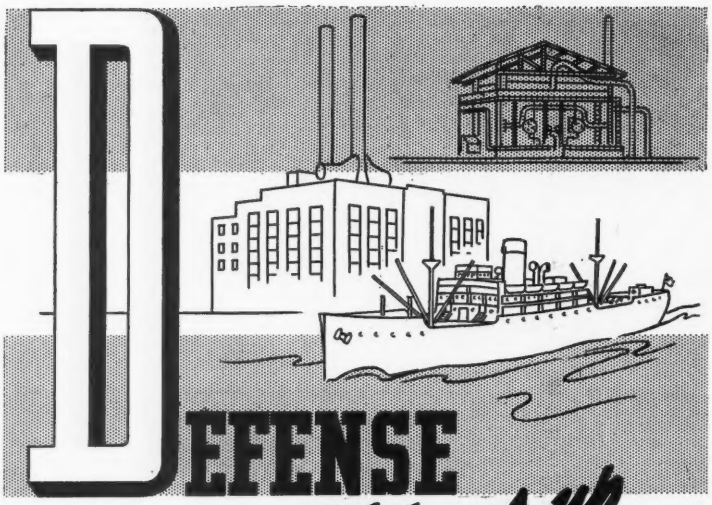
Offered free to aid Defense, this timely Shop Bulletin Service may be had through your local Crane Representative. Call him today!

CRANE

CRANE CO., GENERAL OFFICES:
836 S. MICHIGAN AVENUE, CHICAGO

VALVES • FITTINGS • PIPE
PLUMBING • HEATING • PUMPS

NATION-WIDE SERVICE THROUGH BRANCHES AND WHOLESALERS IN ALL MARKETS



DEFENSE *Steams up*
WITH PEABODY BURNERS

IN new defense plants—in hard working Central Stations and Refineries—in cargo and fighting ships on two oceans—hundreds upon hundreds of Peabody Burners are producing millions of pounds of steam for defying the dictators.

PEABODY BURNERS have been selected for these jobs on land and sea for their recognized dependability and endurance. They meet the most exacting demands, where boilers are driven to answer the call for more and still more power.

Economy and flexibility in the use of fuels are added reasons for Peabody preference. Peabody Burners give complete combustion with oil, gas and pulverized coal, preventing waste and loss at a time when everything must be used efficiently.

We invite inquiries from all those planning to add steam generating capacity, or to modernize existing combustion units. There are types and sizes of Peabody Burners for every combustion job. Let us develop specifications to meet your requirements.

PEABODY ENGINEERING CORPORATION
580 FIFTH AVENUE • NEW YORK
OFFICES IN PRINCIPAL CITIES

NEWS FROM THE FIELD

Louisiana Engineering Society will hold the 1942 Annual Meeting at the St. Charles Hotel, New Orleans, on January 9 and 10, 1942. An interesting program has been arranged including diversified technical papers, prominent speakers, inspection trips and enjoyable entertainment features.

Walter L. Fleisher, president of the A.S.H.&V.E., was recently notified by Dr. H. W. Dodds, president of Princeton University, that he had been elected by the University Board of Trustees to serve for a 2 yr. term on the Advisory Council of the Department of Mechanical Engineering. Mr. Fleisher is a consulting and advisory air conditioning engineer of New York; a graduate of University of Pennsylvania with degrees of B.S., M.S. and M.E.; and is also a member of the A.S.M.E., the A.S.R.E. and the American Society of Bakery Engineers.

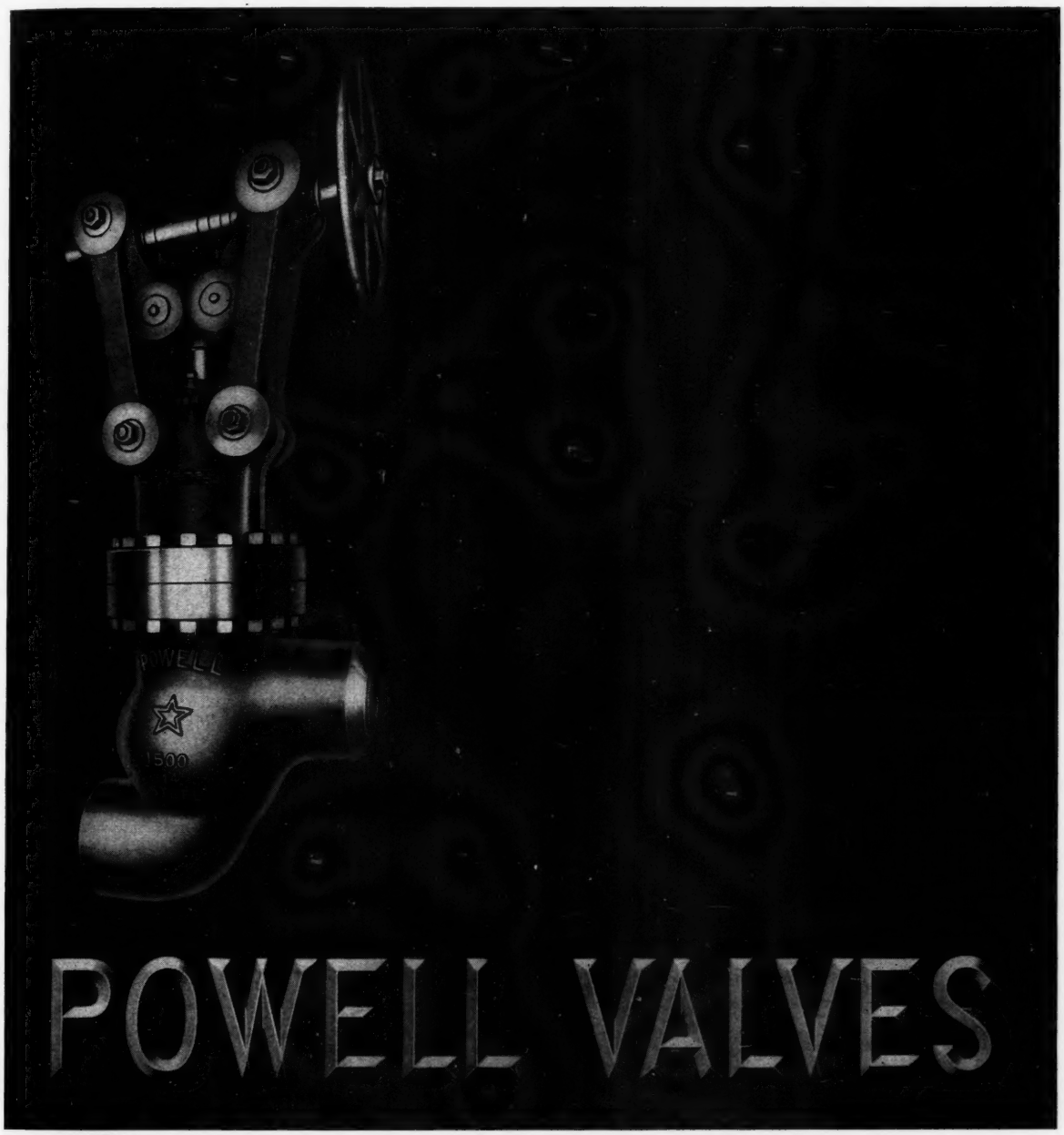
The Virginia Public Service Co., Alexandria, Va., has approved plans for new addition to local steam-electric generating station and will begin work on the superstructure early in 1942. The new 15,000 kw. unit, will increase the capacity of the plant to 45,000-kw. The entire project will cost about $1,600,000, of which $225,000 will be used for the station building, and remainder for equipment and line work. Completion is scheduled late in the fall of 1942.

A. S. R. E. Officers

DR. WILLIAM R. HAINSWORTH, vice-president in charge of engineering of Servel, Inc., New York, and a national authority in the field of refrigeration research, was elected president of the A.S.R.E. at the annual convention in St. Louis, Mo.

Dr. Hainsworth, who has been engaged in refrigeration research more than 20 yr., succeeds L. L. Lewis, vice-president of the Carrier Corp., Syracuse, N. Y., retiring president of the society. In 1933, Dr. Hainsworth was awarded the Charles A. Munroe Award by the American Gas Association for his contributions to the gas industry in the field of scientific research. Becoming affiliated with Servel in 1929, Dr. Hainsworth undertook the direction of extensive research on air cooling and improvements in domestic and commercial refrigeration. In 1935 he became vice-president of the company in charge of engineering.

The Society presented its Distinguished Service Award to William S. Shipley, one of its past presidents, in recognition of his leadership and outstanding effort in developing and bringing into successful use the "York Plan", a co-operative plan for co-ordinating the community's civic and industrial activities in the interest of the National Defense Program. Mr. Shipley is chairman of the board of York Ice Mach. Corp., chairman of the Defense Committee of the Manufacturers Association of York, and chairman of Region No. 10 of the Pennsylvania Division of Contract Distribution, of the Office of Production Management.



Service . . .

Advanced engineering conducted by highly trained specialists using the most modern laboratory equipment. Quantity production on a vast array of up-to-the-minute machines. The readiness and ability of the Powell technicians to lend their experience and skill to the solution of each and every valve problem which is imposed by the constant changes in the present industrial picture.

These are the things that habitual users of Powell Valves become accustomed to. The result of them, as expressed in terms of valves, is sturdiness, efficiency and economy. This, to the people at the Powell plant, is the meaning of service.

Shown here is a 14" Class 1500 lb. Offset Angle-Pattern Toggle Operated Non-Return Valve with welding ends. It is made of cast carbon molybdenum alloy steel. Seat and disc hard faced with Stellite. Engineered and produced in strict accordance with Powell Precision Standards, it is a fine example of the complete line of Powell Valves.

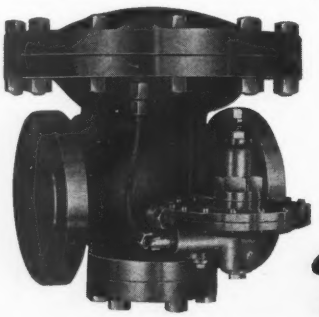
The Wm. Powell Company
Cincinnati, Ohio

A. S. H. & V. E. Convention

FOR A WEEK beginning January 26, those engaged in the heating, ventilating, air conditioning field will have a busy time in Philadelphia. The 48th Annual Meeting of the A.S.H. & V.E. will be held at the Bellevue-Stratford Hotel; the 7th International Heating and Ventilating Exposition, at the Commercial Museum; and the 28th National Convention of the N.W.A.H. & A.C.A. at the Benjamin Franklin Hotel.

For the A.S.H. & V.E. technical sessions will be held each morning at the headquarters hotel and afternoon sessions in the ballroom at the Exposition. There will be seven technical sessions and the Committee on Arrangements for the Philadelphia Chapter have planned a number of entertainment features and a series of inspection trips. Already, 275 leading manufacturers have contracted for space in the Exposition and the variety of exhibits will reveal how such equipment is needed for the defense program and will indicate that this essential industry provides for public comfort and health.

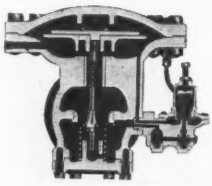
The Committee on Arrangements for the Philadelphia Chapter consists of: M. F. Blankin, General Chairman; H. Berkley Hedges, Vice-Chairman; C. B. Eastman, Vice-Chairman; R. D. Touton, Secretary. Other committee chairmen are: Hotels, Karl Rugart; Publicity, J. H. Hucker; Entertainment, W. P. Culbert; Ladies, Mrs. M. F. Blankin; Banquet, H. H. Erickson; Transportation, L. A. Childs; Inspections, E. H. Dafter; Finance, A. C. Caldwell; Sessions, R. F. Hunger; and Reception and Registration, H. H. Mather.



OK'ed BY POWER ENGINEERS
For Steam Pressure Control

FISHER Type 92
PILOT OPERATED REDUCING VALVE

. . . Has already won the acceptance of power engineers everywhere. Its remarkable performance records of steam pressure control merits YOUR consideration.



Type 92 sectional view showing cross section of pilot assembly.

ACCURATE

Pilot control—with extreme sensitivity to flow changes—maintains desired reduced pressure with remarkable accuracy. No auxiliary operating medium needed.

COMPACT

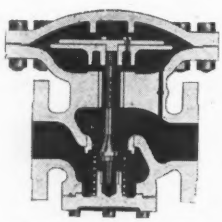
A compact controller with unusually large capacity. Available in 10 sizes from ½" to 2" screwed or 1" to 6" flanged. No special wrenches required for servicing.

FLEXIBLE

Two pilot assemblies for high or low pressure service are available and interchangeable on all Type 92 sizes. Pilot control spring easily adjusted or changed to obtain a variety of reduced pressure ranges.

STURDY

High-tensile bodies and diaphragm casings are extremely rugged, ribbed construction. Inner parts are Duromite bronze or stainless steel—or special material as ordered. Every construction detail designed to assure maximum life.



Type 92 sectional view showing inlet and outlet passages.

Write for Bulletin C1 — gives complete details, prices.

FISHER
GOVERNOR COMPANY
• 1006 FISHER BUILDING •
MARSHALLTOWN, IOWA

New Boston Edison President

JAMES V. TONER was recently elected president of the Boston Edison Co. to succeed the late Frank D. Comerford. Mr. Toner graduated from Holy Cross in 1912 with an A. B. degree. He received the degree of B. B. A. from Boston University in 1925, qualified as a C. P. A., joined the staff of Boston University as instructor on business subjects. In 1927 he received the degree of M. A. from Holy Cross.

He has been with Boston Edison since 1931 when he was elected auditor of the company. A month later he became assistant treasurer and in rapid succession treasurer, vice-president and executive vice-president. He was a close friend and long time collaborator of the late Frank Comerford and shortly after his promotion announced that the company policies of Mr. Comerford would be continued, following plans which they had made together in recent years.

Gas Pipe Line to Ohio

EARLY in December F.P.C. announced its order authorizing issuance of a certificate of public convenience and necessity to Gas Transport, Inc., a wholly-owned subsidiary of the Anchor Hocking Glass Corp. This covered the acquisition and operation of a 14 to 18 in. natural gas pipe line now being constructed by Anchor Hocking and extending 38 mi. from near New Era, W. Va., to the vicinity of Gravel Bank, O. The line will be used to transport natural gas to meet requirements in Anchor Hocking's two glassware plants in Lancaster, O., and will also be used to transport gas for the Ohio Fuel Gas Co. for resale in Cincinnati, Columbus, Dayton, Toledo and other Ohio communities.

Authorization will enable Anchor Hocking to secure natural gas for its manufacturing purposes at a considerable saving over its present purchases. It will also enable Ohio Fuel and its associate Northwestern Natural Gas Co. (Columbia Gas & Electric System) to effect savings approximating in excess of $400,000 during the next calendar year.

Estimated cost of the new line, the order announced today says, approximates $781,524.60, exclusive of compression equipment. Annual operating and maintenance charges approximate $126,604.27, exclusive of additional charges to be incurred after the installation of compression equipment. The order stipulates that the pipe line shall be completed within 30 da. from the date of the issuance of the certificate.

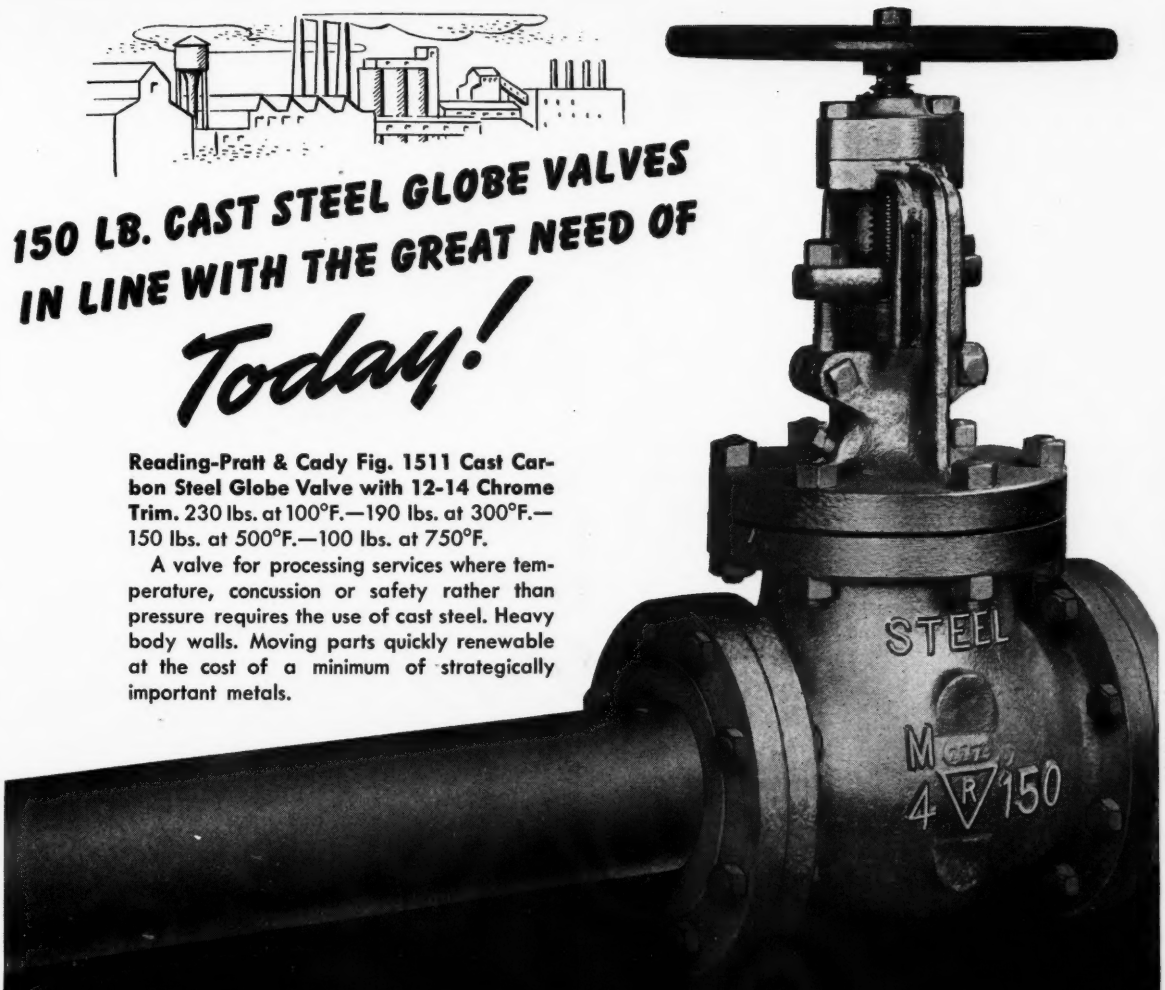
Ohio River Power Co. to Be Sold

CENTRAL U. S. UTILITIES Co., Wilmington, Del., an affiliate of the Associated Gas & Electric System, has filed an application with the F.P.C. seeking approval of the sale of the Ohio River Power Co., to the communities of Tell City and Cannelton, Ind., for the ag-

150 LB. CAST STEEL GLOBE VALVES IN LINE WITH THE GREAT NEED OF *Today!*

Reading-Pratt & Cady Fig. 1511 Cast Carbon Steel Globe Valve with 12-14 Chrome Trim. 230 lbs. at 100°F.—190 lbs. at 300°F.—150 lbs. at 500°F.—100 lbs. at 750°F.

A valve for processing services where temperature, concussion or safety rather than pressure requires the use of cast steel. Heavy body walls. Moving parts quickly renewable at the cost of a minimum of strategically important metals.



Materials are scarce! Conserve them by installing valves which under the gaff of twenty-four-hour operation do not require early replacement and the repeated use of critical materials.

Before buying new valves, take advantage of renewable features. Replace worn parts and continue to use the critical metals in parts still serviceable.

Valves are vital to defense. Our capacity, now fully absorbed by defense work, has been increased and further increase made possible by the recent consolidation of our facilities at Reading, Pa. While scarcity of materials slows the outward flow of production, our position is now very much stronger than it was before the consolidation.

READING—CAST STEEL VALVES AND FITTINGS
PRATT & CADY—BRASS AND IRON VALVES
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A Division of AMERICAN CHAIN & CABLE COMPANY, INC. *Bridgeport, Conn.*

No matter what size or type of tubular equipment you need to descale, you'll do a faster, more economical job with

ROTO TUBE CLEANERS

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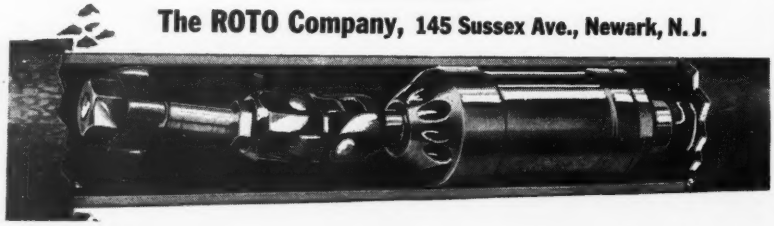
The ROTO Company, 145 Sussex Ave., Newark, N. J.



Change of Address

To avoid missing an issue or paying for forwarding postage be sure to send a change of address to our office. Changes received by the 20th of the month can be made effective for following month's issue.

The application states that the sale will be in furtherance of the objectives of the Public Utility Holding Company Act and of the intention of the S.E.C. requiring the applicant to divest itself of all control or interest in any public utility properties or assets located in the State of Indiana.

New Plant for Waterloo, Wis.

THE WATERLOO Water & Light Commission of the Village of Waterloo, Wis., will meet in the City Hall January 6, at 7 o'clock P.M., to receive and publicly open proposals for furnishing labor and materials to enlarge the existing municipal electric generating and central heating plant building.

This will include: auxiliary equipment and piping; a coal fired steam generating unit; coal handling equipment; stoker; forced and induced draft equipment; chimney, a bleeder type steam turbo-generator with surface condenser; switchboard panel; a deep well with pump, motors, controls, and electric wiring; boiler feed pump and controls; and the necessary steam and water piping systems.

Plans and specifications will be on file in the office of the Secretary of the Waterloo Water & Light Commission in the Village of Waterloo, Wisconsin, where they may be examined by interested parties. Plans and specifications for personal use may be obtained from the Engineers, the Commercial Testing & Eng. Co., 307 N. Michigan Ave., Chicago, Ill., upon making a deposit of $10.00 for each set.

OBITUARIES

Guy F. Strafer, 65, manager of the Allis-Chalmers Mfg. Co., Kansas City district office since 1923, died November 23 at St. Joseph's Hospital, Kansas City, after a brief illness. He started with the Bullock Electric Mfg. Co., Norwood, O., in 1897. Allis-Chalmers acquired the Bullock Co. and Mr. Strafer went to the Allis-Chalmers' Kansas City office in 1907, subsequently becoming its manager.

Gilbert Hambledon Tompkins, Secretary of Sauerman Bros., Inc., Chicago, Ill., died suddenly at his home December 2, 1941. He was born at Butler, New York, September 29, 1884. Shortly after his graduation from Ripon College he joined the Sauerman organization in October, 1909, and was with them continuously from that date. When the business was incorporated on January 1, 1925, he became Secretary of the corporation and remained in that position until his death. He is survived by his window, two sons and a daughter.

Allan H. Jackson, 77, vice president and general counsel of the General Electric Co., until his retirement in 1929, died from heart failure in Schenectady, N. Y., on December 7. He was born in 1864, graduated from Union College in 1886 and from Albany Law School 2 yr. later. In 1902, he joined the General Electric Co.'s legal department and in 1922 was elected vice president and general counsel.

Opened and Closed 500,000 Times

Fig. 0828

Illustration shows an old Fairbanks Sphero Valve, Fig. 0828, in plant of Stokes Bros. Mfg. Co., Freehold, N. J., that was in service for over ten years. This valve was opened and closed every two minutes for an average of five or more hours a day.

This old valve was recently replaced by a new type Fairbanks Sphero Ball Valve, Fig. 0851.

Fairbanks Sphero gives unusual service for blow-off purposes or wherever a full flow, quick-acting valve is desired.

Instead of the usual wedge or disc, Fairbanks Sphero has a revolving ball plug which wipes the seating surface clean. Its shearing action cuts through heavy solids and liquids. There is nothing on which foreign matter can accumulate.

The opening in the ball plug is the same size as that in the pipe, consequently there are no obstructions, no frictional resistance.

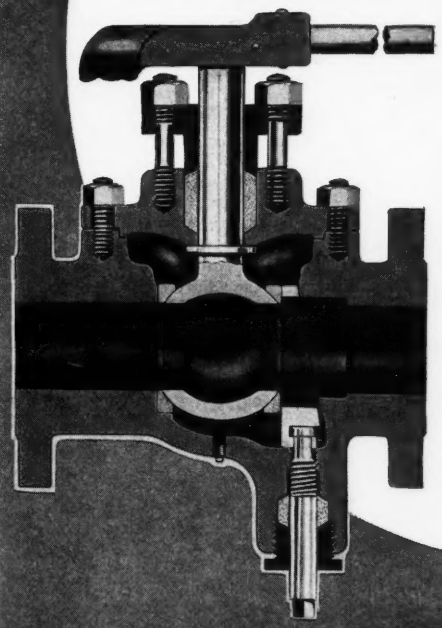


Fig. 0851
250 lbs. steam pressure

Wear on seat rings is reduced to a minimum by the rotary motion of the ball. Seat rings can be kept permanently tight by adjusting the wedge at bottom.

It can be opened or closed with a quarter turn of the handle. A positive stop tells when fully open or closed.

Seat rings or other parts which may become worn, can be replaced without removing valve from the line.

For Catalog No. 21 and name of our nearest distributor write The Fairbanks Company, 399 Lafayette St., New York, N. Y.

F

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Please send your catalog No. 21 and name of nearest distributor.

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Fairbanks Sphero Valves

Install
SIMPLEX METERS

HOW much water is going into steam? . . . Are boilers working at top efficiency at all times? . . . How much gas are we using each day in certain departments or in the whole plant?

Let Simplex Meters give you the accurate "candid camera" flow data you need for closer control of plant operations and to prevent costly waste.

Simplex Meters are equally accurate and reliable when used for measuring ALL types of fluids. They are furnished in any size and for operating pressures up to 2500 lb. Write today for Bulletin No. 52.

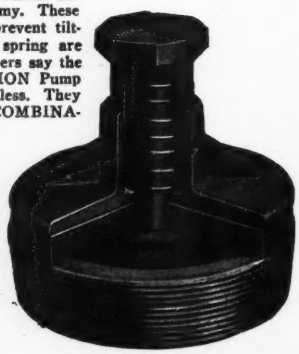
SIMPLEX VALVE & METER CO., 6790 Upland St., Philadelphia, Pa.

PUMP SLIPPAGE WASTING YOUR STEAM?

Let This STRAIGHT-LIFT Valve Prove Its Money Savings In Your Plant

Today's call for increased, all-out defense production leaves no place for "below-par" pump performance. Scores of engineers have found COMBINATION Pump Valves the surest way to step up pump efficiency and economy. These "Straight Lift" Valves are built especially to prevent tilting and consequent slippage. Seat, stud and spring are made of long-lasting Phosphor Bronze. Many users say the steam and replacement savings of COMBINATION Pump Valves repay their cost in six months' time or less. They match the splendid performance delivered by COMBINATION Silent Check Valves.

SPECIAL OFFER: So confident are we that COMBINATION Pump Valves will pay real dividends in your plant that we make this amazing trial offer. Install a set of them on one of your pump jobs (Boiler Feed, Vacuum, Condenser, General Service). And if you are not satisfied that these improved non-tilting valves are paying back their cost in a reasonable time, return them and they will not cost you a single penny. Decide now to take advantage of this chance to *get more pump capacity with less steam.* Mail the memo below for full details.



COMBINATION PUMP VALVE CO.
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Without obligation, please send me full details about your Trial Offer on COMBINATION Pump Valves.

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Company.....
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FOR THE ENGINEER'S LIBRARY

Coupon for obtaining free literature listed here may be found on page 146, under the heading Helpful Bulletins.

STEAM PLANT EQUIPMENT

1 Boilers—A new 8-pp. booklet describes the B&W Integral-Furnace Boiler Classes 9, 12, and 15 for capacities as low as 135-hp. or 9000 lb. steam per hr. and for stoker or oil firing. Illustrations and drawings show details of operation and construction features. The Babcock & Wilcox Co.

2 Stokers—Iron Fireman Poweram stokers, with installation, results, details, controls and efficiency are treated in an 18 p. catalog, Form 7121. Iron Fireman Mfg. Co.

3 Coal Crusher—Bulletin No. 941 gives the latest information available on McNally Pittsburg Stoker Coal Crushers of all types; the latest improvement being a new ratchet take-up which will adjust the crushing rolls while the crusher is in operation without losing valuable time and stoker coal tonnage. McNally Pittsburg Mfg. Corp.

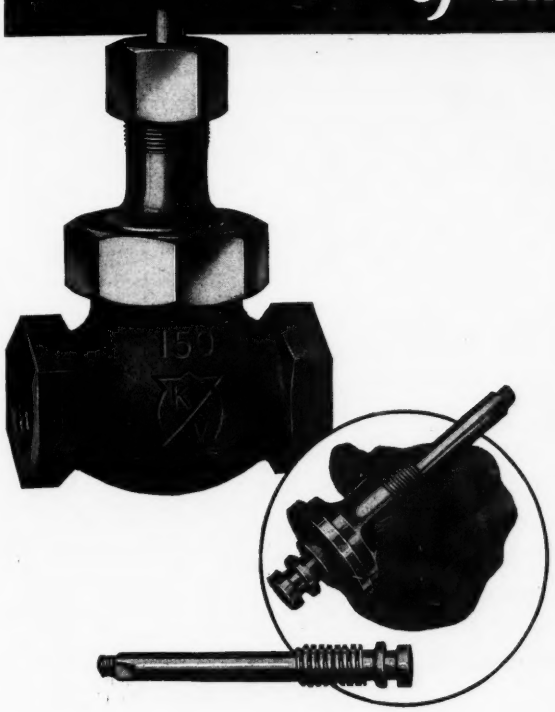
4 Refractories—A new 69 p. booklet entitled Complete Refractory Service is made up of two parts: The first half, a catalog section on the company's bricks, plastics and cements; the second, a handbook of tables useful in figuring the number and combinations of brick in firebrick construction. General Refractories Co.

5 Refractory—Adahearth for constructing monolithic hearths for forges and slag tap boiler furnaces is treated in a recently released circular. Botfield Refractories Co.

6 Inspection Doors—A new 4 p. folder describes the Gillette furnace inspection door for industrial furnaces, boilers and kilns for temperatures up to 2500 deg. F. Gillette Kiln Sales Co.

7 Valves—Catalog No. 12—G5, a new folder describing hard surfaced integral seat globe stop valves, carrying the trade name Intex, for pressures to 1500 lb. at 950 deg. F., has recently been issued. The disk and integral seat are faced with Stellite, a high hardness alloy, which is extraordinarily resistant to both erosion and corrosion. The Edward Valve & Mfg. Co., Inc.

Inspect the MACHINE WORK *of any Kennedy Valve*



NOTICE the smooth, true surfaces, accurate threading, clean finish and perfect fit of all parts. Kennedy machinists are long-experienced, and the strictly modern automatic machine tools with which they are provided enable them to turn out flawless work.

The result—Kennedy Valves look trim and clean-cut; and, more important, they operate easily, close tightly, are readily taken apart and reassembled, and all parts are interchangeable.

The Kennedy 150-lb. Renewable-Composition-Disc Bronze Globe Valve which is illustrated has these additional important "extra values".

- Union bonnet ring and packing nut made of malleable iron for extra strength; cadmium plated for permanent protection against rusting
- Bronze-to-bronze true union joint between bonnet and body
- Special machined low friction contact surface between stem head and disc holder for easy operation
- Raised seat in body is unusually high for longer disc life
- Slipon disc holder has four guide prongs to prevent binding—locks in wide-open position but releases at a half-turn of the stem
- Stem has large number of heavy contact threads to reduce wear
- Conical joint between stem and bonnet permits packing under pressure
- Stuffing box is exceptionally deep with self-lubricating molded packing and long gland follower
- Non-heating comfortable-grip handwheel

Every other Kennedy Valve type, too, has several "extra value" features that make Kennedys the best possible valve investment. Specify Kennedys on your next valve order and you will quickly see the advantages of standardizing on them. Obtainable at your local dealer.

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Products include

VALVES

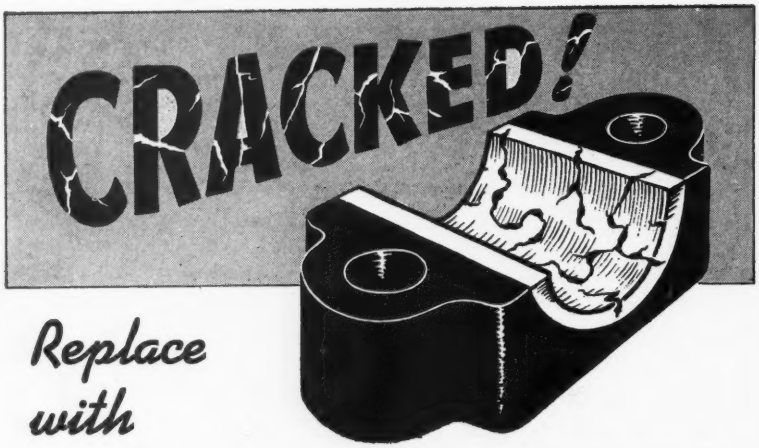
Iron-Body and Bronze Gate, Globe, Angle and Check

PIPE FITTINGS

Malleable Iron and Bronze Screwed Fittings; Cast-Iron Flanged Fittings and Flanges

The Kennedy Valve Mfg. Co.,
Elmira, N. Y.

KENNEDY
VALVES with Extra Value



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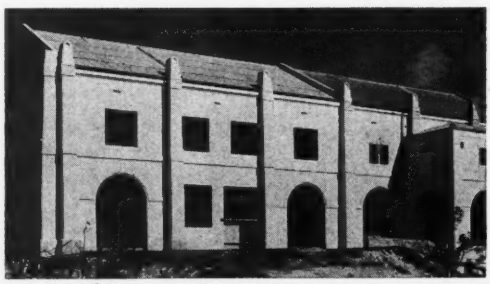
NORDBERG DIESEL



AT BERMUDA ISLAND

THE 8 cylinder Nordberg Diesel shown at the left is installed in the Bermuda Electric Light, Power & Traction Co., Ltd., plant at Pembroke, B. I. To minimize the chance for interruption of fuel supply, a Nugent Duplex Fuel Oil Filter is used (shown in circle).

The big thing to remember about Nugent Duplex Filters is that the patented construction gives you up to 20 times more actual filtering area than other types of construction. This means very low oil flow velocity through filter . . . longer intervals between cleaning . . . less maintenance . . . less labor expense. Write for further details.

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Sight Feed Valves, Flow Indicators, Compression Union Fittings, Oil Pumps, Etc.
423 N. HERMITAGE AVE. Established 1897 CHICAGO, U.S.A.

8 Steam Hook-Ups—Recently released is a new 42 p. book of engineering data on selecting, sizing, and installing steam traps, temperature regulators, water mixing valves, and heating system specialties with 75 hookup sketches of correct steam piping for all types of industrial and heating equipment. Sarco Co., Inc.

INSTRUMENTS AND CONTROLS

9 Automatic Control—New general Catalog No. 41 describes standard items in the Masoneilan line of automatic controllers, reducing valves, back pressure regulators, pump governors, float valves, etc. It includes illustrations and technical data. Mason-Neilan Regulator Co.

10 Industrial Controls—A 56 p. catalog No. 8301 in two colors illustrates and describes controls for temperature, pressure, humidity, combustion safeguard and liquid levels by electric, pneumatic and combination methods. The Brown Instrument Co.

11 Telemetering Instruments—Micromax Telemetering and Totalizing Recorders for Electric Power is a new 28 p. bulletin No. N-58-161 (superseding bulletin 874) covering completely the use and application of these instruments in power stations and industrial plants. Catalog N-58-161. Leeds & Northrup Co.

12 Instruments—A new 8 p. condensed catalog No. C-10 describes the complete line of Meriam manometers, draft gages, indicating flow meters, pressure gages, tank gages and accessories. The Meriam Co.

13 Combustion Instruments—Bulletin 419 is a 4 p. folder covering the application of Ess Electric Eye instruments for indicating, recording and controlling combustion changes. Ess Instrument Co.

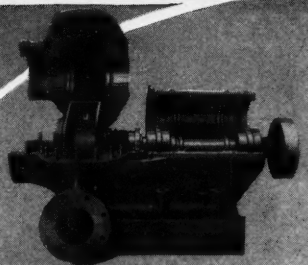
14 Thermometers—Catalog No. 9004 is a comprehensive presentation of the nature, design, performance and application of Brown Resistance Thermometers in industrial processes, scientific work, refrigeration, air conditioning, etc., which involve the measurement and control of temperature. Schematic diagrams and explanation of the principle of the Wheatstone Bridge Circuit are included. The Brown Instrument Co.

WATER TREATMENT

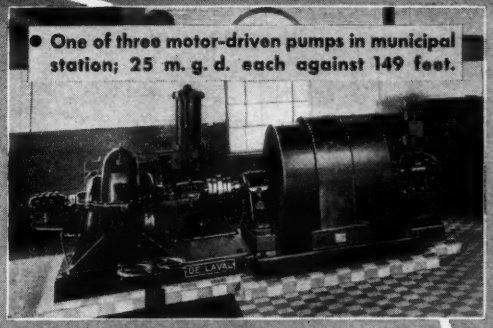
15 Supplementary Treatment—Supplementary Water Treatment for Boiler Feedwater is the title of a new 12 p. Bulletin No. 2420 presenting a complete discussion of the various ways in which chemicals may be fed to boilers to further condition the water after external water treatment. The Permutit Co.

16 Boiler Water—A new booklet explains in full the treatment of boiler feedwaters in "Nature's Own Way" with "Baerite" Organic Formulas. Written in semi-technical style the booklet explains the functions of Baerite Organic Formulas in balancing waters which cause rust, scale, corrosion, foaming, priming and other boiler troubles. Water Treatment Co. of America.

A DE LAVAL PUMP
to fit your job



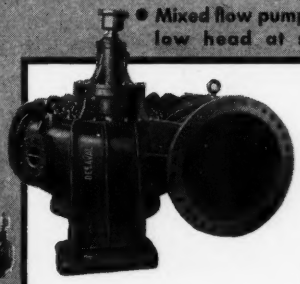
• Clogless pump, for paper pulp, sewage, etc.



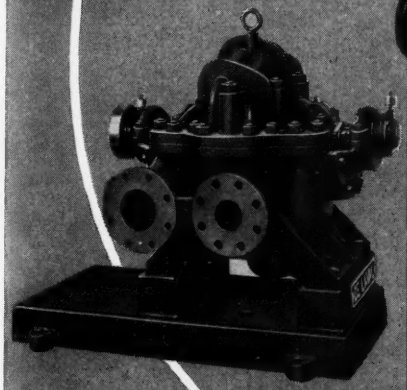
• One of three motor-driven pumps in municipal station; 25 m. g. d. each against 149 feet.

• Condenser circulating pump for salt water; bronze bearings, monel shaft and impeller.

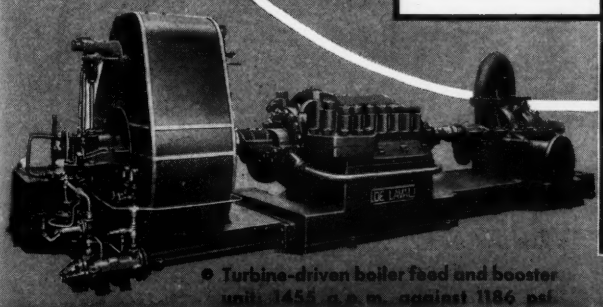
• Mixed flow pump, for large volume against low head at standard motor speed.



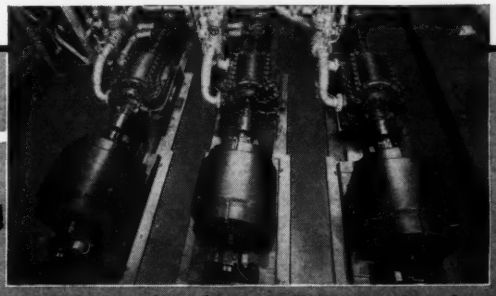
INFINITE combinations of capacities, heads and speeds require careful design of each centrifugal pump to insure best efficiency and desired operating characteristics. • Where a liquid having a destructive effect on standard materials is to be handled, the life of a pump can usually be increased many times over, and its average efficiency improved, by using special alloys for casing, impeller, sleeves, wearing rings and shaft. Only by careful study of user's conditions are the best results to be obtained. • State your pumping requirements in detail so that the engineers of our Centrifugal Pump Department may give you all the benefit of their extensive experience. Ask for Leaflet P-3220.



• Opposed impeller pump; compact; perfectly balanced; only two pairs of wearing rings.



• Turbine-driven boiler feed and booster unit; 1455 g. p. m. against 1186 psi.



• Multistage de-scaling pumps; 1200 g.p.m. each against 1200 psi. at 1750 r.p.m.

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MANUFACTURERS OF TURBINES . . . STEAM, HYDRAULIC, PUMPS . . . CENTRIFUGAL, PROPELLER, ROTARY DISPLACEMENT, MOTOR-MOUNTED, MIXED-FLOW, CLOGLESS, SELF-PRIMING; CENTRIFUGAL BLOWERS and COMPRESSORS, GEARS . . . WORM, HELICAL and FLEXIBLE COUPLINGS

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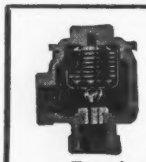
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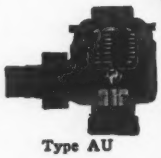
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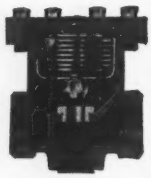
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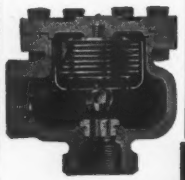
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NO AIR-BINDING—All types discharge air just as efficiently as water.

NO FREEZE-UPS—Types A, AU and C drain completely when cold, hence cannot freeze.

NO ADJUSTMENT—Same adjustment used for any pressure from vacuum up to the maximum allowable with construction used.

NO DRIBBLING—Closes immediately when steam contacts bellows.

NO WATER-LOGGED UNITS—Requires but a few degrees temperature differential between steam and condensate to open valve.

Write for Steam Trap Catalog No. 240.

OTHER NICHOLSON PRODUCTS—
Piston and weight operated steam traps, compressed air traps, gasoline traps, steel and stainless steel floats, flexible couplings, 3 and 4-way valves, compression shaft couplings, expanding mandrels, arbor presses, steam eliminators and separators.

Bulletins on request.

W. H. NICHOLSON & CO.
160 Oregon St. Wilkes-Barre, Pa.

17 Zeolite Softeners—Zeolite Water Softening is the title of recently released 8 p. Bulletin 112 dealing with problems and processes of water softening. Included with a complete description are illustrations of typical installations. The American Water Softener Co.

18 Water Treatment—Water Marks is the name of a new house organ which gives information on developments and current results being obtained in the treatment of water for boilers, stills and evaporators. It carries concise technical explanations of various methods of water treatment, with special reference to the reasons for the rapidly increasing use of all-organic colloidals. American K.A.T. Corp.

ELECTRICAL

19 Electrical Insulators—Permission has been secured from Electronic Engineering of London, Eng., to reprint and distribute in America Dr. Ing. E. Rosenthal's paper on The Electrical Properties of High Frequency Ceramics. Much of the data in this paper have not been hitherto published and should be of interest to engineers using technical ceramic insulation. American Lava Corp.

20 Protective Lighting—Recommended floodlighting practice for night time production or protection of outdoor areas near manufacturing and construction projects is described in a new 22 p. bulletin B-2280. Westinghouse Electric & Mfg. Co.

21 Plant Equipment — Motors and control, switchgear, power conversion, voltage transforming and regulating equipment, also instruments and automatic switches are shown in bulletin G.E.D.-978 devoted primarily to chemical plant equipment. General Electric Co.

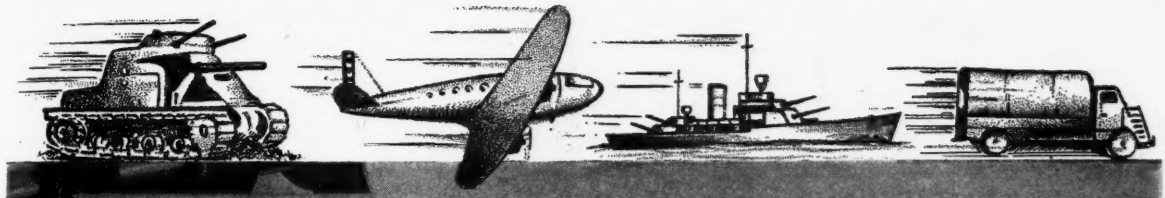
22 Motor Starter—For use with squirrel-cage, synchronous and wound-rotor motors, with current limit fuses and short-circuit and overload protection, G.E. 2300-v., metal-enclosed contactor starter is shown in catalog GEA-3660. General Electric Co.

23 Electron Tubes—A new 32 p. bulletin reports, with photographs and tests, a decade of pioneering in cathode-ray equipment and television. Allen B. Du Mont Laboratories, Inc.

24 Electric Cable—Construction and application of GF gas-filled cable for 10 to 40 kv. service is described in a new 12 p. bulletin in color, GEA-3652. General Electric Co.

25 Switchgear—Metal-clad switchgear of the vertical lift type is described in a new bulletin GEA-3649, devoted principally to the application of this equipment in oil refineries. General Electric Co.

26 Relays — Polyphase power-directional relays of the high speed induction-cup type with details of construction, wiring diagram and characteristics are covered in a new 24 p. booklet, GEA-2827A. General Electric Co.



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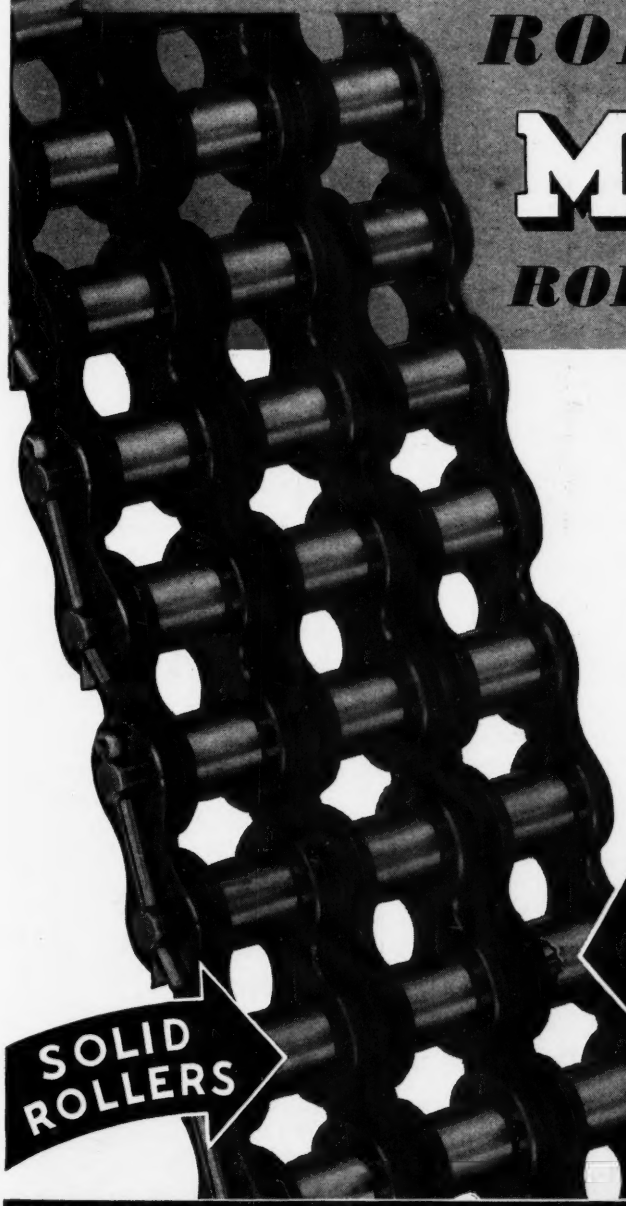

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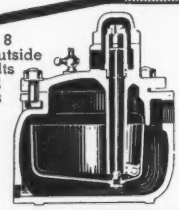

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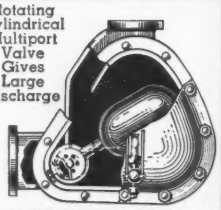

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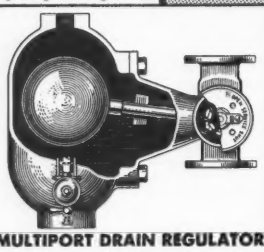

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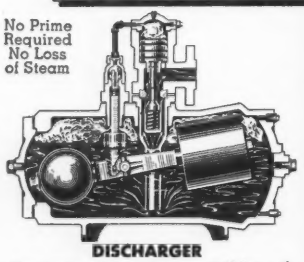

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27 Electronic Control — Thy-mo-trol CR7507 for the control and operation of variable speed d.c. motors from a.c. lines is described in a new 8 p. bulletin, GEA-972A. General Electric Co.

28 Motors—Single-phase, direct-current, and small polyphase motors are treated in Bulletin MU-183, with detailed descriptions of the construction of repulsion-start-induction, repulsion-induction, capacitor-start, split-phase, direct-current, small polyphase, fan and explosion-proof motors. Wagner Electric Corp.

PAINTS AND COATINGS

29 Paint Specifications—Facts about U. S. Government Finishes is a 13 p. loose-leaf folder with data on widely used finishes usually identified in Army and Navy specifications only by code. The booklet tells how and where they are applied, gives manufacturer's material costs, thinning and drying data and other essential information necessary to figure costs accurately and establish the most efficient production schedule for particular equipment. Roxalin Flexible Lacquer Co.

30 Paint Technique—Three Dimensional Seeing is the title of a truly astonishing 24 p. booklet on research and studies of a new color science developed by A. A. Brainerd of the Philadelphia Elec. Co. for improving industrial seeing conditions through the correct combination of light and color. The book is well illustrated with photographic examples of what has been accomplished by color and paint in representative shop and factory locations. E. I. Du Pont de Nemours & Co., Inc.

31 Protective Coatings—The Tycol Line of Protective Coatings is the title of a new 45 p. booklet dealing with detailed and essential information on protective and waterproof coatings. Sections treat rubber coatings, various types of waterproofing, metal conditioning and other processes of cleaning, priming and coating surfaces. Protective Coatings, Inc.

32 Waterproofing—Application of new rubber-base compounds to stop leaks and prevent corrosion in brick, concrete, stucco and other types of masonry as well as on metal surfaces are described in a new 4 p. booklet entitled Banish Old Man Wet with Primoid Waterproofing Products. Primoid Products Corp.

MISCELLANEOUS

33 Diesel Sets—Making one's own electricity with Caterpillar Diesel Electric Sets at a stated cost of 1 cent per kw-hr. is explained, and many installations throughout the country are shown, in an attractive 20 p. booklet. Caterpillar Tractor Co.

34 Pumps—A special pump operating on a new Squeegee Principle suitable for pumping of liquids or gases and made in sizes from 1½ to 100 g.p.m. is described in a new 6 p. folder. Huber Pump Div., Downingtown Mfg. Co.

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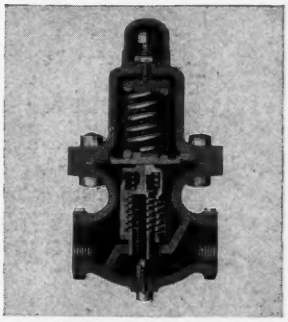
Iron or bronze bodies; bronze trim; pressures up to 350 lbs.; top temperature 500° F. Screwed ends; sizes ¼" to 2".



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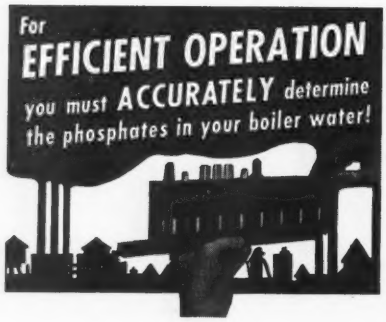

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35 Patents—Patent Background for Engineers, is a 55 p. booklet containing reprints of 15 interesting articles on patents and inventions, originally published in the Allis-Chalmers Electrical Review. These articles stimulated so much interest that the editors of the "Review" decided to reprint them as an engineer's handbook on Patent law. Allis-Chalmers Mfg. Co.

36 Humidifiers—Steam type humidifiers, their use, advantages and control are illustrated and described, with sizes and capacities in circular Form 150-1041-5-2. Armstrong Machine Works.

37 Insulation—Fabricated Insulation is the title of a recently released 16 p. catalog dealing with Reyn-O-Cell insulation. Construction and uses are illustrated and described. Reynolds Metals Co.

38 Plant Protection—Identifying Employes and Preventing Unauthorized Entry and Tightening Up Industrial Plant Guarding are two new bulletins recently published dealing with scientifically planned plant entrance and exit control systems for industrial plants, shipyards and other areas. Perey Turnstile Co.

39 Portable Power Tools—The complete 1942 line of Thor Portable Electric Tools is described in an attractive new 64 p. catalog No. 37. Containing four major sections, the book gives complete descriptions, specifications and prices on the entire Thor line of universal type electric drills, drill stands, screw drivers, nut setters, tappers, saws, hammers, nibblers, grinders, polishers and electric tool accessories. Independent Pneumatic Tool Co.

40 Welder Switch—A power switch called the Weld-O-Trol, designed to speed up production in resistance welding, is described in a new 6 p. folder, B3025. A schematic diagram shows how the Weld-O-Trol, in sizes of from 150 to 1200 amp. frame, opens and closes the circuit to the primary of the welding transformer, and, the selection of Ignitron tubes is simplified by a chart. Westinghouse Electric & Mfg. Co.

41 Springs—A new die spring bulletin describes and prices die springs for high-speed presses, regular-speed presses, and heavy-duty presses. Muehlhausen Spring Corp.

42 Scaffolding—Complete details of Quik-Set Safety Steel Scaffolding for above floor painting, wiring, machine repair and similar uses are given in an 8 p. catalog which explains the construction that permits easy assembly and dis-assembly with only a few strong, light weight parts. Mechanical Handling Systems, Inc.

43 Belting—Catalog section 2186 on Open End V-Belting describes V-belting in long lengths, used with fasteners, for installations which are inaccessible for application of endless V-belts. The section lists the standard sizes in which the belting is available, limitations, minimum recommended pulley diameters, rules for applications and fasteners and tools used. The B. F. Goodrich Co.

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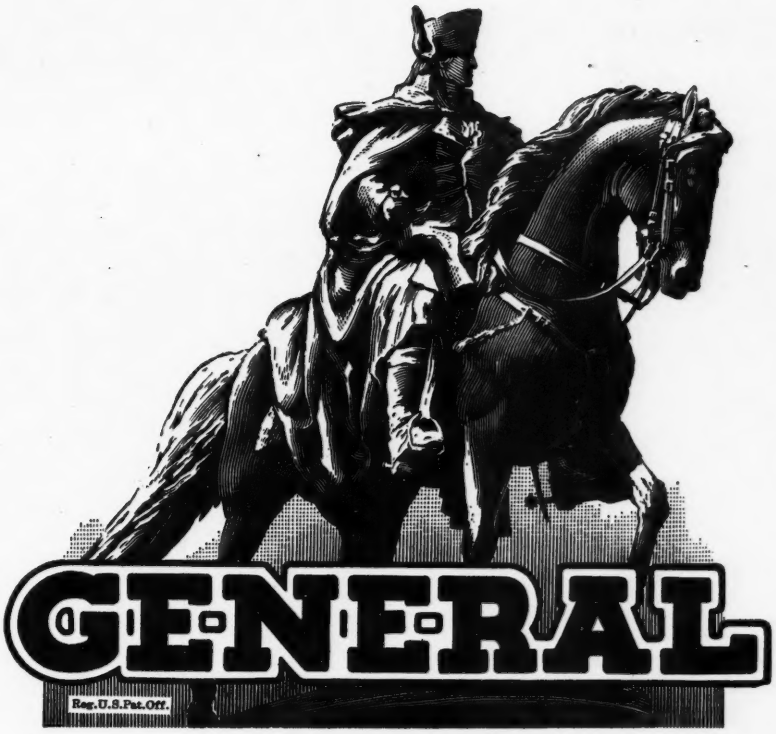

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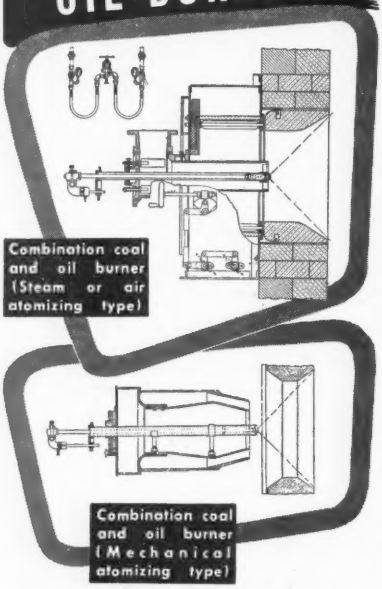
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Enco Burners

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45 Alloys—Technical data on the latest creep-stress of B&W Croloys and other tubular materials for high-temperature service has recently been issued on a card designated as TDC-102-B. Requests must be made on company letterhead. The Babcock & Wilcox Tube Co.

46 Plastics—Solutions To Your Transparent Enclosure Problems With Lucite is the title of a new 16 p. booklet showing the application of Lucite, a transparent plastic, to various industrial problems. Sent only to executives, business men and engineers upon request on their company letterhead. E. I. du Pont de Nemours & Co., Inc.

47 Steel Tubes—Technical Bulletin 6-D covers Properties of Carbon and Alloy steel tubing for high temperature and high pressure service. It is a complete revision and enlargement of the previous edition and includes new data on physical properties resulting from the company's research during the past 3 yr. New sections have been added on the manufacturing process, rupture testing, maximum allowable working stresses, steel for sub-zero application, effect of hydrogen, and air-hardening properties. Requests must be on company letterhead or must indicate the company connection. The Babcock & Wilcox Tube Co.

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2. ***Widened range of dependable fuels.***

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5. ***Installations easily adaptable to existing or new boilers.***

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6. ***Low fuel costs.***

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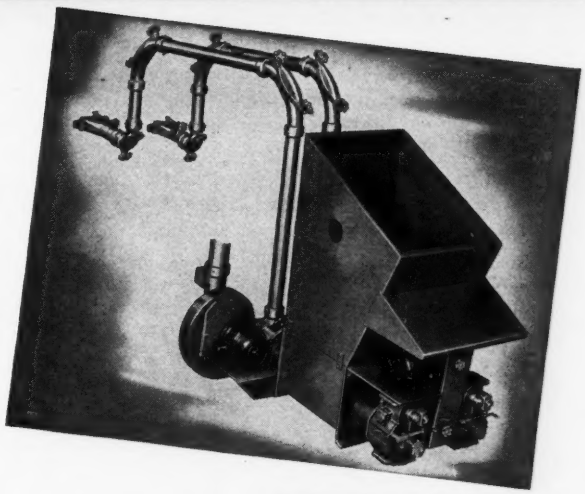
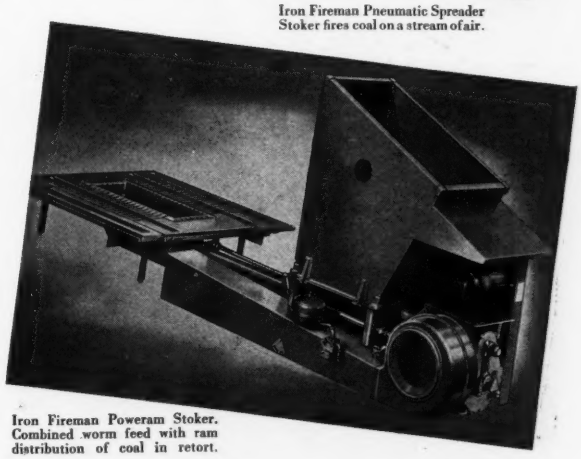


Iron Fireman Pneumatic Spreader Stoker fires coal on a stream of air.



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New Engineering Books

Wartime Government Bulletins. Following are some recent bulletins prepared by different departments of the Government and dealing with various phases of wartime activities. Most of these publications should be ordered from the Superintendent of Documents, Government Printing Office, Washington, D. C. Remittances should be sent by postal money order, express order, check (not stamps) or 5 ct. coupons issued by the office in units of 20 each. Unless otherwise noted bulletins should be obtained direct from the department mentioned. (A list of British official publications selling at from 5 to 15 ct. may be obtained from the British Library of Information, 50 Rockefeller Plaza, New York City.)

Blackouts. This is a 60 p., 8 by 10½ in. paper bound, illustrated booklet prepared by the War Dept. for the Office of Civilian Defense. It deals with the general phases of blackouts, planning and physical preparation for individual dwellings, stores, factories, utilities, communities and transportation facilities. Detailed directions are given for the use of paints, guide lighting, industrial light control, window protection by wool mattresses and building construction. For sale by the Supt. of Documents, price 25 ct.

Protective Construction. A 6 by 9 in., 36 p. (with seven large scale construction drawings) prepared by the Engineer Corps for the O.C.D. and issued as Structures Series, Bulletin No. 1. This is a technical bulletin dealing with the velocity, angle of impact, pressures and effect of different size bombs; protection of buildings, plants and factories by sandbag walls and special construction; air raid shelters; and a special reference bibliography. For sale by the Supt. of Documents, price 25 ct.

Protection of Industrial Plants and Public Buildings. A 12 p. bulletin outlining the organization of, and main points in connection with, protection of employees, plants and equipment so as to maintain production at the highest possible rate. U. S. Office of Civilian Defense, Washington, D. C.

Suggestions for State and Local Fire Defense. A 27 p. 6 by 9 in. paper bound book prepared by the Advisory Committee on Fire Defense, as Fire Series Bulletin No. 1 for the Office of Emergency Management. For sale by the Supt. of Documents, price 10 ct.

Air Raid Warning System. An 18 p., 8 by 10½ in. outline of organization for air raid warning systems. Prepared by the War Dept. for the Office of Civilian Defense.

Handbook for Air Raid Wardens. A 4½ by 7½ in., 24 p. manual, giving duties, standard symbols, typical observation layouts and essential data for wardens. For sale by the Supt. of Documents, price 10 ct.

Civilian Protection. The why, what, how, who, when and where of combat and community protection in wartime. A 14 p., 6 by 9 in. bulletin of general information. U. S. Office of Civilian Defense.

Emergency Medical Service. A 12 p., 8½ by 11 in. pamphlet, prepared by the Medical Div. of O.C.D., showing plans and organization charts for emergency medical service. U. S. Office of Civilian Defense.

Municipal Signaling Systems. Memorandum on such systems with particular emphasis on (and specifications for) emergency electric power equipment. Prepared for the Office of Emergency Management. For sale by the Supt. of Documents, price 10 ct.

Doing Business with the Procurement Division. Prepared and distributed by the Procurement Div. of the Treasury Dept., Washington, D. C., for the guidance of prospective bidders, particularly those firms which have heretofore hesitated to deal with the government through lack of knowledge of the procedure. (The War Dept. issues similar bulletins called Army Purchase Information, and the Navy Dept. one entitled "Selling to the Navy" see p. 80-84, December, 1941, issue for the part played by the Div. of Contract Distribution, O.P.M. in co-ordinating the purchases of these departments and also for a list of branch offices).

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Fire Defense. Edited by Horatio Bond. Published by the National Fire Protection Association, 60 Batterymarch St., Boston, Mass. Size 6 by 9 in., paper bound, 213 pp., copyright 1941. Price $1.50.

This is a comprehensive, practical well edited compilation of material on safeguarding industrial production from fires, bombs and sabotage. It is divided into six parts, several of which are concerned with the organization and activities of municipal fire departments, water supply and communications. Part VI, however, deals entirely with industrial plant protection; principles of plant protection; private fire brigades; and pointers on equipment and organization necessary to maintain effective protection. Part I is general, dealing with incendiary bombs, bomb handling, magnesium and its alloys, materials which form the principal ingredient of incendiary bombs. Part II deals with sabotage and arson, both extremely important in time of war.

A smaller 12 p. bulletin Fire Defense Programs, published by the same association, sells for 10 ct. and outlines suggestions for Defense Councils and committees of states and municipalities.

Performance of Pressure-Type Oil Burners, by M. P. Cleghorn and R. J. Helfinstine, is the title of a 32 p. Bulletin 151 published by the Iowa State College, Ames, Iowa. It includes comprehensive tests and dimensions of four oil burners in two domestic furnaces to determine the efficiency of the burners, effect of CO_2 on efficiency, effect of furnace construction, insulation, etc.

Programs of the Research Technical Advisory Committees of the American Society of Heating and Ventilating Engineers. This 48 p. booklet contains the personnel of each committee, a briefly stated scope of activity, a comprehensive outline of planned research investigations, available laboratory facilities, a list of publications emanating from each committee program, and typical illustrations showing equipment in the several research laboratories. A bibliography of research reports is also included, together with regulations governing committees.

A limited number of copies of the booklet are available and may be obtained upon request from the American Society of Heating and Ventilating Engineers, 51 Madison Ave., New York, N. Y. Also reprints of many of the research reports listed in the bibliography are available for distribution at a nominal cost of 10 or 15 ct. each.

Blacklist. A revised blacklist of 2536 Latin-American companies and individuals with whom manufacturers in the United States are forbidden to trade has just been published by the New York Journal of Commerce, 63 Park Row, New York, N. Y. Copies are 10 ct. each.

Diesel Engine Operation. Prepared by a staff of Technical Experts under the direction of E. Malloy. Chemical Publishing Company, Inc., 240 King Street, Brooklyn, N. Y. 1941. 5½ by 8½ in., 96 pp. Cloth. Price $2.00.

This book is intended for erectors, installation and plant engineers and all who are concerned with the practical side of Diesel engine operation. It describes the 2-stroke and the 4-stroke cycles of combustion and deals fully with practical considerations involved in the installation and maintenance of cold start oil engines. Particular attention is given the matter of fuel pumps, with notes on tracing and remedying faults. The chapter dealing with oil engine installations includes reference to both Diesel and semi-Diesel types, the subject being dealt with from the preparation of the engine room and site and the laying of foundations, to the final starting up. As Diesel engine indicators and their accessories are quite different from those used in steam engine practice, a separate chapter has been devoted to them and the measurement of horsepower and the use of the planimeter in connection with indicator diagrams.

Thermodynamics. By Joseph H. Keenan. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York. Size 6 by 9 in., 488 pp., cloth bound. Price $4.50.

The author, professor of Mechanical Engineering at M.I.T., is perhaps best known among engineers for his work on the properties of steam and as the co-author of the Keenan & Keyes Steam Tables now in almost universal use in this country. (See p. 74, January, 1937.) As such, the engineer may well be justified in expecting more than just another textbook on thermodynamics, something different to bridge the gap between theory and practice.

These things the author has done very well. The treatment is relatively free from algebraic manipulation, ele-

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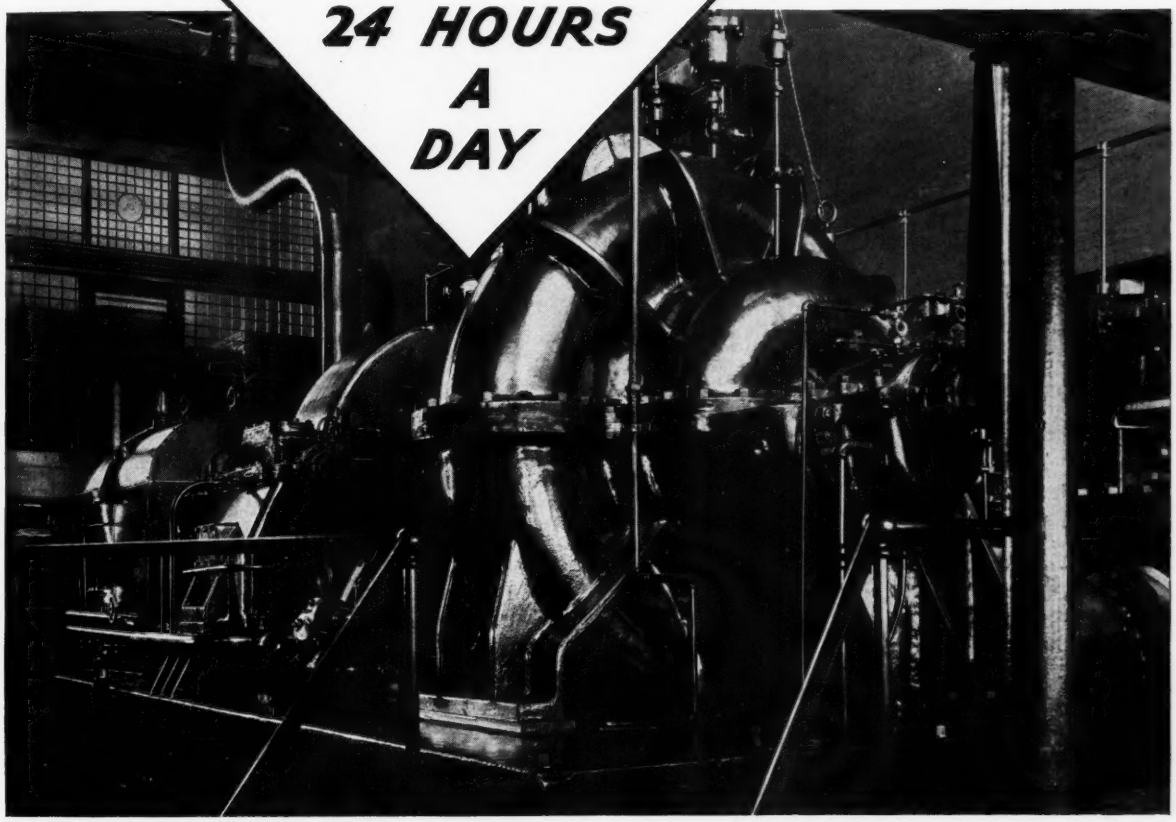

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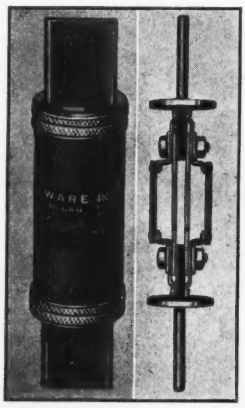

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mentary points are made clear by simple mechanical analogies, examples are drawn from familiar things, processes and simple chemical reactions, and the illustrations are clear, simple and understandable.

The book is in three well defined parts. The first is a rigorous treatment of fundamental theory involving the first and second laws of thermodynamics. The second part deals with the application of these laws to practical engineering in engines, turbines, Diesels, refrigeration and various cycles. While the approach is from the standpoint of thermodynamics rather than engineering, the simplicity, clearness and thoroughness of the treatment is such that it covers these phases to better advantage than most books written from a more "practical" viewpoint.

Part three of the book, intended primarily for graduate study is perhaps the most outstanding, of greatest interest to those with a working knowledge of thermodynamics, and is the part that carries the book far beyond the limits of the conventional text on thermodynamics.

It is in effect a resume or correlation of the recent work on the more involved phases of thermodynamics which border on certain other fields of chemistry and physics, particularly those involving chemical reactions (see Thermodynamics for Chemical Engineers by Harold C. Weber, p. 142, January, 1940). Liquid and vapor phases, concentrations, partial pressures, supersaturated vapor and superheated water, equilibrium and binary mixtures are some of the topics covered.

This is not a book that can be read as a novel but one intended as a text book covering three terms of college work and therefore requiring intense study. For an engineer with a background of thermodynamics interested in keeping abreast of the field it is recommended as a "must" book.

Building Insulation. By Paul D. Close. Published by the American Technical Society, Drexel Ave. at 58th St., Chicago, Ill. Size 5½ by 8½ in., 318 pp., washable cloth binding. Price $3.00.

Perhaps no phase of construction involves so many controversial problems as insulation and so many opinions on the best insulation, or the best type, how much to use it, where to apply it and what the saving in fuel will be. One reason for this is that there is no universally accepted method of rating insulations.

Obviously there are many factors and conditions which must be taken into consideration in endeavoring to establish a preference as to the type of insulation and to determine the best there must be a measuring stick. The information given in this book should enable the prospective user of insulation to determine the type and thickness best adapted to his requirements, based on the specific conditions under which the material will be used.

An effort has been made by the author to avoid discrimination, to treat all products fairly and without bias and to state the facts as they are known in such a manner as to be useful and of practical value to the architect or engineer, to the manufacturer, to the dealer, to the consumer and for the training of salesmen of insulation and lumber.

Although it deals primarily with domestic insulation, the principles involved are of course applicable to any insulation problem involving comparable temperatures, particularly those sections dealing with condensation, pipe and duct insulation, sound insulation, acoustics and machinery isolation. The author is Technical Secretary of the Insulation Board Institute and was formerly technical secretary of the A. S. H. & V. E.

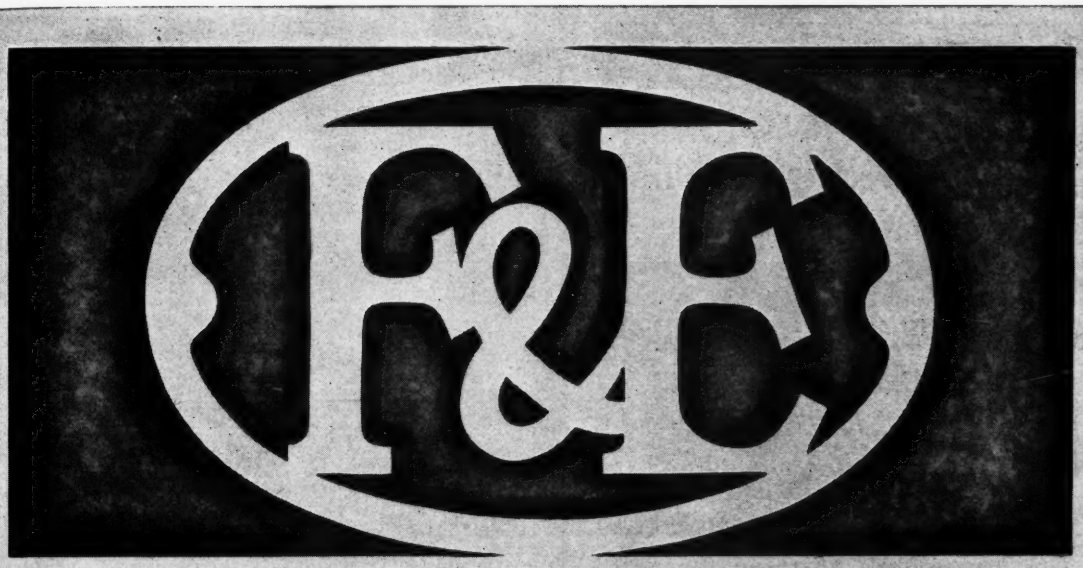
Wire and Wire Gauges. By F. J. Camm. First Edition. Chemical Publishing Co., Inc., 240 King St., Brooklyn, N. Y. 1941. 4¼ by 6¾ in., 138 pp. Cloth. Price $2.50.

This handy little book gives each of the standard wire systems separately. With the increasing use of wire such a book will be found useful for engineers, electricians and those who work in wire industry. A special section on wire rope adds to the value of the work.

Electric Power Statistics, 1920-1940. This is compiled and sold by the Federal Power Commission, Washington, D. C. It sells for 25 ct. a copy and is designed as FPC S-20. It is a 163 p. report presenting for the first time complete data on electrical production, generating plant capacity and fuel consumption for each state for the years 1920 to 1940.

Flight—Aviation Engines. By Ray F. Kuns. Published by the American Technical Society, Drexel Ave. at 58th St., Chicago, Ill. Size 6 by 9 in., 354 pp., washable cloth binding. Price $3.25.

From elementary engines as a foundation, the book goes into details regarding aircraft engine fuel, mixtures, carburetor design, use and repair of carburetors, fuel injectors,



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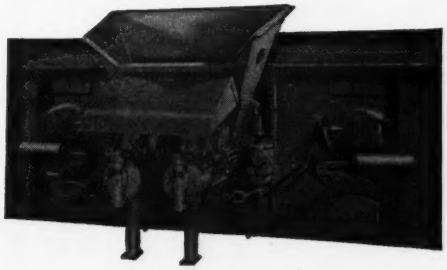

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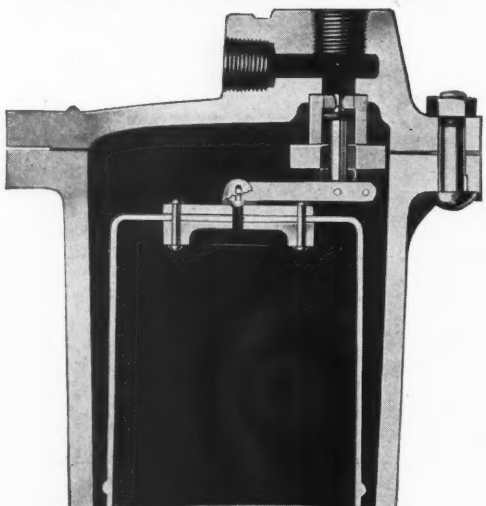

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induction systems, superchargers, radio shielding and storage batteries. Next is a discussion of starters, starting motors, generators and accessories, followed by a thorough explanation of various makes of light plane engines and then radial aircraft engines, valve and ignition timing and lubrication. At the end of the book is a series of quiz questions with answers.

Flight—Meteorology and Aircraft Instruments. By Capt. Bailey Wright, Rex Martin and W. E. Dyer. Published by the American Technical Society, Drexel Ave. at 58th St., Chicago, Ill. Size 6 by 9 in., 340 pp., washable cloth binding. Price $3.25.

The content of this book is much broader than indicated by the title for it covers not only the instruments themselves but their use and application. The last part of the book, some 73 pp., is devoted to the instruments actually used in the plane for flight and navigation while the balance of the book deals with the broader aspects, such as aviation radio, signal systems, airway markers and illumination. Fully half of the book is devoted to what may be termed byproducts of the airplane: weather forecasting and meteorology aerial photography; maps and charts. There is also a chapter of quiz questions.

Both books, Aviation Engines, and, Meteorology and Aircraft Instruments are expanded revision of material formerly published by the Junior Air Service of America; and both are companion volumes to First Principles, and, Construction and Maintenance reviewed on p. 144 of the September, 1941 issue.

Water Measurement. By Wayne D. Criddle and Eldon M. Stock. Published as Bulletin No. 2 by the Utah State Engineering Experiment Station, Utah State Agricultural College, Logan, Utah. Size 6 by 9 in., 51 pp.; paper bound.

This bulletin explains the common devices used to measure water principally in connection with irrigation purposes, and provides by graphic presentation, simple solutions to water measurement problems. It covers in considerable detail the use and application of weirs, rating flumes, submerged orifices, commercial gates and pipe discharge devices for water measurements.

Improvement of Reversible Dry Kiln Fans. By A. D. Hughes. Published as Bulletin Series No. 16 by the Engineering Experiment Station, Oregon State College, Corvallis, Oregon. Size 6 by 9 in., 52 pp., paper bound. Price 25 ct.

This is the report of a research project by the Engineering Experiment Station in cooperation with the Western Pine Association and the Moore Dry Kiln Co. A special test duct for testing full-size 60-in. fans was constructed and 22 fans tested. Since the disk fans commonly used in dry kilns operate under peculiar flow conditions, standard fan test code and procedure cannot be strictly applied to their testing.

A shorter method was devised for the tests made in this project which gave the necessary accuracy and cut the time to about one tenth that required by standard procedure. Improvement in present installations can be made by the installation of special stationary shroud rings while the performance of newly designed fans can be improved by using a smaller number of blades, smaller blade angles, higher speeds, larger hub and the stationary shroud ring.

It is questionable if the use of curved sheet metal blades would be economical. The design and selection of fans for known kiln conditions has been simplified by the use of "efficiency contour" and "air volume per horsepower" curves as presented in the bulletin.

Turbine Practices is a new handbook covering direct-connected sets and 25-cycle and direct-current geared sets in three classes: turbine units; synchronous generators, turbine-driven; and d.c. generators, turbine-driven. Copies may be had from National Electrical Manufacturers Assn., 155 East 44th St., New York City. Price 50 ct.

Circuit Breakers is a new 30-p. edition of Large Air Circuit Breaker Standards with instructions for installation, operation and maintenance. Copies are available from National Electrical Manufacturers Assn., 155 East 44th St., New York City. Price 75 ct.

Possible Substitutes for Zinc Coatings on Steel is the title of a 24 p., 6 by 9 in. booklet recently issued by the American Iron & Steel Institute, 350 Fifth Ave., New York, N. Y. The price is 25 ct. It covers various metallic, nonmetallic and organic coatings with notes on the surface preparation of sheets for different coatings.

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During the post-war period of readjustment, you may be faced with the unpleasant necessity of turning employees out into a confused and cheerless world. But you, as an employer, can do something *now* to help shape the destinies of your people. Scores of business heads have adopted the Voluntary Pay-roll Allotment Plan as a simple and easy way for every worker in the land to start a *systematic* and *continuous* Defense Bond savings program.

Many benefits . . . present and future. It is more than a sensible step toward reducing the ranks of the post-war needy. It will help spread financial participation in National Defense among all of America's wage earners.

The widespread use of this plan will materially retard inflation. It will "store" part of our pyramiding national income that would otherwise be spent as fast as it's earned, increasing the demand for our diminishing supply of consumer goods.

And don't overlook the immediate benefit . . . money for defense materials, quickly, continuously, *willingly.*

Let's do it the American way! America's talent for working out emergency problems, democratically, is being tested today. As always, we will work it out, without pressure or coercion . . . in that old American way; each businessman strengthening his *own* house; not waiting for his neighbor to do it. That custom has, throughout history, enabled America to get things done *of its own free will.*

In emergencies, America doesn't do things "hit-or-miss." We would get there *eventually* if we just left it to everybody's whim to buy Defense Bonds when they thought of it. But we're a nation of businessmen who understand that the way to get a thing done is to *systematize* the operation. That is why so many employers are getting back of this Voluntary Savings Plan.

Like most efficient systems, it is amazingly simple. All you have to do is offer your employees the convenience of having a fixed sum allotted, from each pay envelope, to the purchase of Defense Bonds. The employer holds these funds in a separate bank account, and delivers a Bond to the employee each time his allotments accumulate to a sufficient amount.

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How big does a company have to be? From three employees on up. Size has nothing to do with it. It works equally well in stores, schools, publishing houses, factories, or banks. This whole idea of pay-roll allotment has been evolved by businessmen in cooperation with the Treasury Department. Each organization adopts its own simple, efficient application of the idea in accordance with the needs of its own set-up

No chore at all. The system is so simple that A. T. & T. uses exactly the same easy card system that is being used by hundreds of companies having fewer than 25 employees! It is simple enough to be handled by a check-mark on a card each pay day.

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Sending the coupon does nothing more than signify that you are anxious to do *something* to help keep your people off relief when defense production sloughs off; *something* to enable *all* wage earners to participate in financing Defense; *something* to provide tomorrow's buying power for your products; *something* to get money *right now* for guns and tanks and planes and ships.

France left it to "hit-or-miss" . . . and *missed. Now* is the time for *you* to act! Mail the coupon or write Treasury Department, Section A, 709 Twelfth St. NW., Washington, D. C.

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Power Plant Construction News

Conn., Bridgeport—United Illuminating Co., New Haven, Conn., has plans under way for expansion in Steel Point steam-electric generating station at Bridgeport, for increased capacity in steam division. Work will include installation of high-pressure boilers and auxiliary equipment. No estimate of cost announced. Westcott & Mapes, Inc., 139 Orange Street, New Haven, is consulting engineer.

D. C., Washington—Bureau of Supplies and Accounts, Navy Department, Washington, will receive bids until Jan. 9 for nine Diesel engine-generator sets, 500-kw. rating, complete with accessories, for emergency service at Brooklyn, N. Y., Philadelphia, Pa., and Norfolk, Va., navy yards (Schedule 9721). Also, until Jan. 9 for 565 hand-driven testing generators for Brooklyn, N. Y., and Mare Island, Calif., navy yards (Schedule 9702).

Fla., Sebring—Light and Water Department, D. H. Durrance, superintendent, has plans maturing for expansion in municipal power plant, to include installation of engine-generator unit to double present capacity. Cost estimated at $131,000, of which $65,000 will be secured through Federal aid and remainder through bond issue.

Ill., Chicago—United Drill & Tool Co., 411 West Ontario Street, manufacturer of twist drills, dies and other cutting tools, plans installation of electric power equipment in new local plant for production of ordnance equipment for Government. It will consist of several large units, estimated to cost about $1,942,700. Fund in that amount will be furnished by Defense Plant Corporation, Washington, D. C., a Federal agency, for project.

Ill., Geneseo—Municipal Electric Light & Power Utility, South State Street, is considering expansion in municipal power plant, including installation of new Diesel engine-generator unit and auxiliary equipment. Cost reported over $45,000.

Ill., Meredosia—Central Illinois Public Service Co., Springfield, Ill., will begin work soon on new steam-electric generating station at Meredosia, with installation of turbine-generator unit and accessories, high-pressure boiler, and auxiliary equipment. No estimate of cost announced.

Ill., Princeton—Water and Light Department has approved plans for expansion and improvements in municipal power plant, including installation of new turbine-generator unit and auxiliary equipment. Cost reported over $55,000. Generating unit will be furnished by General Electric Co., Schenectady, N. Y., and awards for other required equipment will be made soon.

Ind., Burns City—Bureau of Yards and Docks, Navy Department, Washington, D. C., plans construction of steam power station at depot at Burns City. Cost reported over $85,000, with boiler units and auxiliary equipment.

Iowa, Waverly—Municipal Electric Light Department has plans for expansion and improvements in power station, to include installation of a new 700-kw. generating unit and auxiliary apparatus. Cost reported about $90,000. It is proposed to carry out work early in 1942.

Kan., Lindsborg—At recent special election, bond issue of $51,000 was authorized for installation of new engine-generating unit and auxiliary equipment in municipal power plant. A proposal to issue a larger amount, previously noted in these columns, was rejected. Work will be in charge of Municipal Water and Light Department, and is scheduled to be carried out soon. O. E. Olson is superintendent at plant.

La., Baton Rouge—Standard Oil Co. of Louisiana, Inc., 2134 St. Charles Avenue, New Orleans, La., plans installation of boilers, tanks, electric power equipment and other apparatus in connection with expansion in oil refining plant at Baton Rouge, comprising several large units for increased production of high-octane gasoline for aviation service. Proposed to begin

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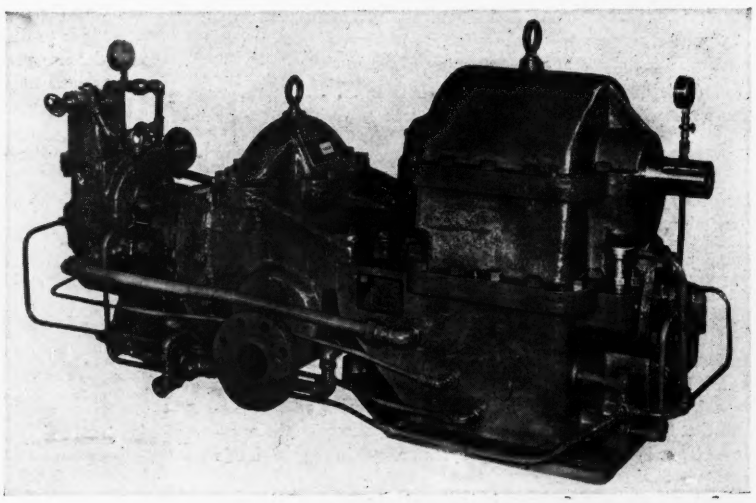

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work early next spring. Cost reported over $15,000,000.

Md., Baltimore—Maryland Drydock Co., Fairfield district, plans new steam power plant in connection with expansion and modernization in shipbuilding plant, now in progress. Cost reported close to $50,000, with boiler units and auxiliary equipment. Entire project will represent an investment in excess of $3,500,000. J. E. Greiner Co., 1201 St. Paul Street, is consulting engineer.

Mo., St. Louis—Scullin Steel Co., 6700 Manchester Avenue, plans installation of electric power equipment in new plant on neighboring site for production of welded armor plate for army tanks for Government. It will consist of a main one and multi-story unit and adjoining smaller structures. Entire project will cost about $2,600,000, of which approximately $2,100,000 will be used for machinery and equipment purchases. Fund in amount noted will be furnished by Defense Plant Corporation, Washington, D. C., a Federal agency.

N. J., Newark—Port Newark Shipbuilding Corporation, Port Newark, and 17 Battery Place, New York, N. Y., recently organized, plans power house, about 70 by 75 ft., at new shipbuilding plant at Port Newark, where former shipyard has been leased from city, to be used for construction of concrete barges for Government. Also will install electric power equipment in new shops and other structures to be erected. Entire project is reported to cost over $350,000.

N. J., New Brunswick—Mack Mfg. Corporation, 97 Jersey Avenue, New Brunswick, manufacturer of motor trucks, plans installation of electric power equipment in one-story addition on adjoining site, about 100,000 sq. ft. of floor space, for production of army tank transmissions for Government. Work will begin soon. Entire project will cost over $400,000.

Ohio, Avon—Cleveland Electric Illuminating Co., Cleveland, Ohio, will begin work soon on steel frame superstructure for addition to steam-electric generating plant at Avon Lake. Additional equipment will be installed for increased capacity. No estimate of cost announced. Project will include extensions in transmission lines.

Ohio, Gallipolis—Buckeye Rural Electric Cooperative, Inc., Gallipolis, plans new electric generating station for power supply for rural electric system. Cost reported over $200,000. Proposed to begin work soon. Financing will be carried out through Federal aid.

Pa., Philadelphia—Bureau of Supplies and Accounts, Navy Department, Washington, D. C., will receive bids until Jan. 6, for two 1000-kw., 240-volt turbo-generator units, two circuit breakers, and spare parts for Philadelphia navy yard (Schedule 9744).

Pa., Williamsport—Aviation Mfg. Corporation, Lycoming Division, manufacturer of aircraft engines, parts, etc., plans installation of electric power equipment in new one-story plant, about 380 by 425 ft., for production of engine units for Government. Work is scheduled to begin at once. Cost about $625,000. Fund in that amount will be furnished by Defense Plant Corporation, Washington, D. C., a Federal agency, for project.

Texas, Houston—Hughes Tool Co., 300 Hughes Street, manufacturer of oil well drilling tools and kindred products, plans installation of electric power equipment in new plant in vicinity of city for production of gun tubes and cannons for Government. It will consist of a number of large units, with power house, power substation for central station service, and miscellaneous structures. It will be known as Dickson Gun Plant and is estimated to cost close to $12,000,000. Fund in that amount will be furnished by Defense Plant Corporation, Washington, D. C., a Federal agency, for project.

Texas, Temple—Brazos Electric Transmission Co-operative, Inc., Temple, plans new steam-electric generating station for power supply for rural electric system. Cost estimated about $1,000,000. Fund in that amount is being secured through Federal aid.

Va., Glen Lyn—Appalachian Electric Power Co., Roanoke, Va., has approved plans for addition to steam-electric generating station at Glen Lyn, with installation to include a new 80,000-kw. turbine-generator unit and accessories, high-pressure boiler and auxiliary equipment. Work will begin soon. No estimate of cost announced.

Va., Norfolk—Bureau of Supplies and Accounts, Navy Department, Washington, D. C., will receive bids until Jan. 9 for 190 portable, motor-driven, submersible pumps, complete with motors, controllers and spare parts, for Norfolk navy yard (Schedule 9725). Also, until Jan. 8 for 200 portable, gasoline engine-driven pumping units for Norfolk yard; and for 70 similar pumping units for Mare Island navy yard, Vallejo, Calif. (Schedule 9660).

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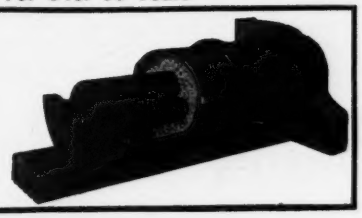

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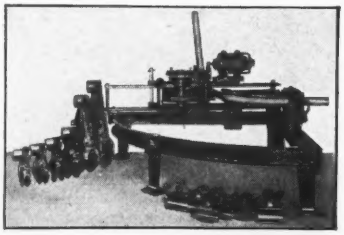

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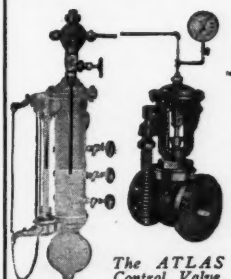

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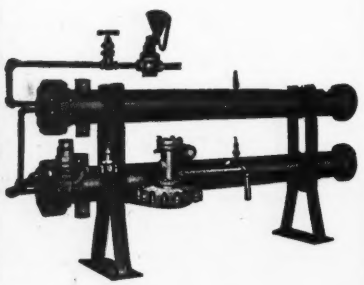

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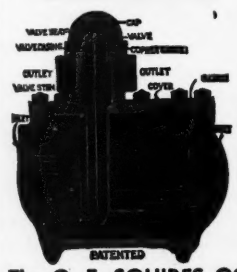

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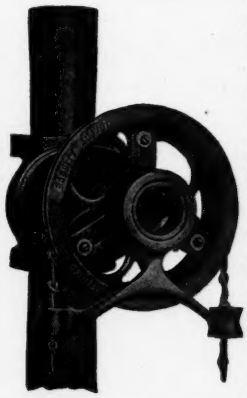

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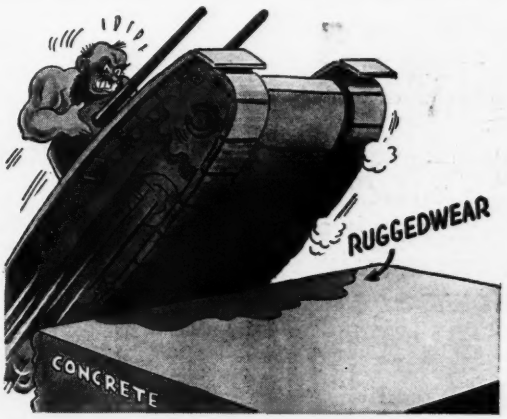

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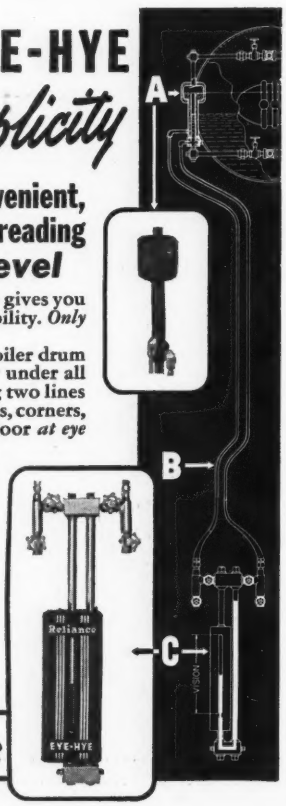

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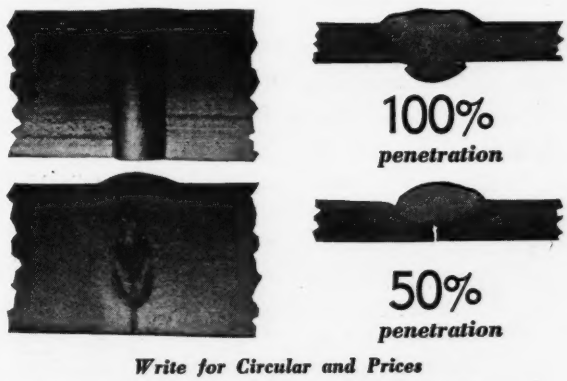

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Through Better Sizing The "AMERICAN Way"

24-30 American Ring Crusher at John Morrell & Co. plant. It handles 50 t.p.h. bituminous coal 6 in. feed, reducing to ½ in. and under for pulverized fuel use

BY passing their incoming coal through a 24-30 AMERICAN Ring Crusher, John Morrell & Co., at Ottumwa, Iowa, makes sure of more nearly perfect sizing. And more uniform sizing, of course, means a higher and more constant CO_2, reduces the carbon content of the ash, makes coal dollars buy more steam.

The money-saving experience of this busy packing plant is being duplicated in scores of industrial plants and central stations where AMERICAN Crushers—used in either stoker or pulverized coal burning—are reducing total fuel costs from 2½ to 8%.

AMERICAN Rolling Ring Crushers differ from other centrifugal crushers in that their housings are heavy steel castings, reinforced with ribs making them unbreakable from any crushing strain. Material to be crushed is struck by rings in suspension which shatter and distribute the coal before it reaches the breaker and grinding plate. By a simple adjustment of the patented grinding plate (made of manganese steel to insure long wear) run-of-mine or lump size is reduced to proper size in one operation.

SPLITS THE COAL

One of the patented shredder rings of the American Crusher—an exclusive feature that splits the coal to uniform size and prevents clogging

AMERICAN Ring Crushers have capacities of 10 to 500 tons per hour, are built special for each installation and guaranteed for definite performance. Let AMERICAN Crusher engineers co-operate in getting better coal sizing and lower steam costs in your plant.

AMERICAN PULVERIZER COMPANY
1429 Macklind Avenue
St. Louis, Missouri
ORIGINATORS AND MANUFACTURERS OF RING CRUSHERS AND PULVERIZERS

Investigate **GREEN**

MECHANICAL DRAFT FANS
AIR PREHEATERS
ECONOMIZERS
CINDERTRAPS

for that needed increase in capacity and with a return up to 100% on your investment

IF YOUR power plant dates back to the early twenties — if you are not using modern heat recovery equipment — if you are pushing that plant sixteen, eighteen, twenty-four hours a day in the "all out" for national defense, we can save thousands of dollars for you — yearly.

For example, substantial savings can be made through the installation of a Green Fuel Economizer. When you remember that there is a one percent direct fuel saving for every ten degrees rise in feed water temperature, you should see the dollars-and-cents value of such an installation.

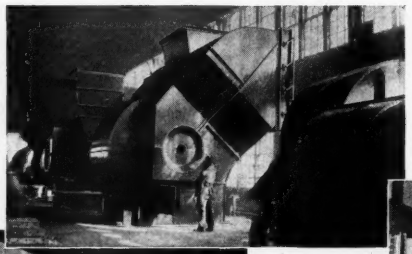
The total savings effected the first year often exceed the first cost of this equipment—and then pay a generous dividend throughout years of service. Why not consult Green—now?

A representative will call on request.

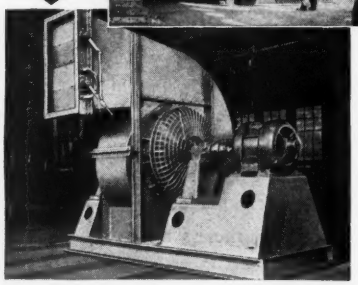
1-GF-1

THE GREEN *Fuel Economizer* COMPANY INC.
BEACON NEW YORK

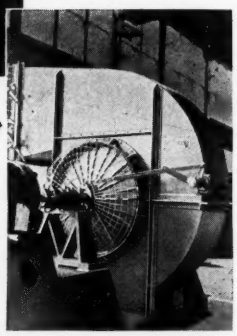
FORCED DRAFT FANS
Custom built for every mechanical draft service. All types of volume control. For heavy duty service. Efficient, dependable, economical.

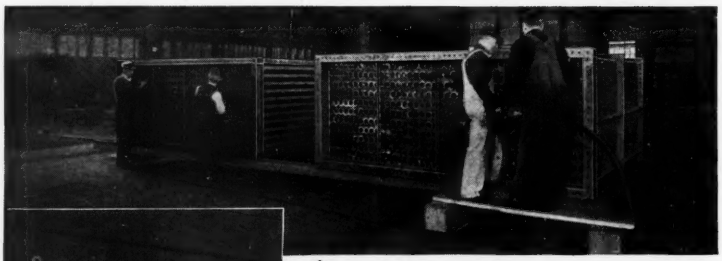


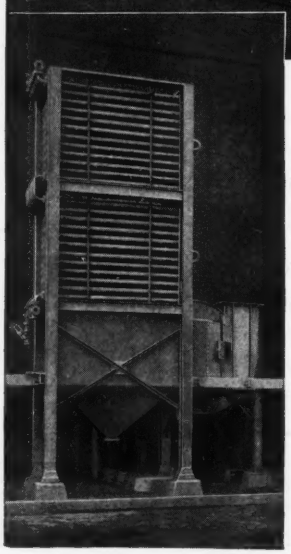
INDUCED DRAFT FANS
For mechanical draft service. All speeds. Especially designed to retard abrasion from cinders and dust.



INLET VANE CONTROL
For varying fan capacity with constant speed motor drive of sturdy design for heavy duty service.

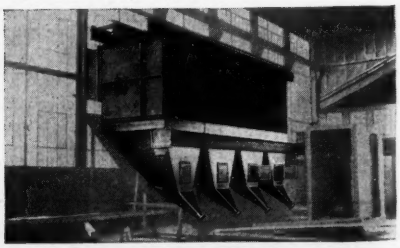






AIR PREHEATERS
Tubular and plate types of cast iron or steel. Waste heat recovery with minimum maintenance. Many in service with gas temperatures to 2300°.

FUEL ECONOMIZERS
Cast iron and steel having many advantages proven by years of service. Cast iron types built for pressures up to 450 lbs. per sq. in. and steel tube extended surface type to 1625 lbs. per sq. in.

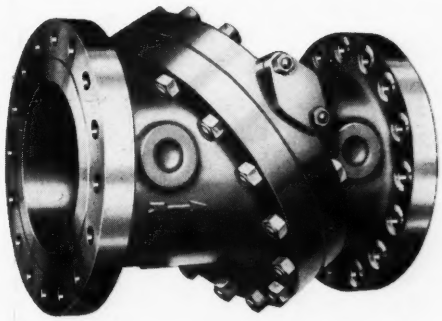


CINDERTRAPS
For stoker fired boilers. Good recovery—low draft loss (0.1" to 0.2"). Tested in accordance with the latest A.S.M.E. Tentative Code.

IN POWER PLANTS - COAST TO COAST

Chapman

TILTING DISC CHECK VALVES



OUTSTANDING ADVANTAGES

Non-slam—cushioned closing.

Aerofoil disc rides the flow without flutter—reducing wear and replacement of moving parts.

Less resistance to flow—saves power, increases line capacity.

Closes drop-tight—stays tight.

Equally efficient when installed horizontally or vertically.

Made in iron, steel or alloy best suited to requirements, and for pressures to 1500 lbs.

A *crash stop* in an automobile, airplane, gun recoil or pipe line is bad business, and usually spells destruction or expensive repairs. The checking action in Chapman Tilting Disc Check Valves is positive and quick, but perfectly cushioned. There is no "slam" to strain the line or open up joints. They have many other important advantages over standard swing-type checks, and are setting new records for efficiency and low cost of maintenance in power applications.

THE CHAPMAN VALVE

MANUFACTURING COMPANY

INDIAN ORCHARD, MASS.

How Permutit* boiler treatment speeds production in 10,000 steam plants

ENDS BOILER SCALE

PREVENTS CORROSION

STOPS FOAMING AND PRIMING

PERMUTIT ***Water Softening Equipment***

includes the most modern types to fit every individual plant requirement: Fully automatic zeolite softeners, hot and cold lime soda water softeners and Permutit's latest process: ZEO-KARB*. This amazing non-siliceous zeolite removes both hardness and bicarbonates from the water, leaving it soft and reduced in total solids and alkalinity. The sulphate-carbonate ratio may be adjusted as desired by a system of mixed effluents.

PERMUTIT ***Deaerating Heater***

gives sure protection against corrosion because it's guaranteed to remove all oxygen (Winkler test) and free CO_2. It has been supplied for pressures up to 150 and for capacities to 1,400,000 pounds per hour. This economical equipment utilizes bled or exhaust steam.

PERMUTIT
Continuous Blowoff

maintains a uniform concentration of salts in the boiler salines. Both high and low flash types. Heat from the blow-off water is recovered by means of flash tanks and heat exchangers, resulting in appreciable savings. Available in a number of types to suit specific heat balance requirements.

Bring your water problem to the world's largest manufacturer of water conditioning equipment

Let Permutit's field engineers help you to work out plans that will get the most out of your plant. Write for free booklets: The Permutit Company, Dept. A1, 330 West 42nd Street, New York, N. Y.

In Canada, call upon the Permutit Company of Canada, Ltd. . . . Montreal . . . Toronto . . . Winnipeg . . . Calgary.

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WATER CONDITIONING HEADQUARTERS